THURSDAY, APRIL 21, 1887

GOEBEL'S OUTLINES OF THE CLASSIFICATION OF PLANTS

Outlines of Classification and Special Morphology of Plants. By Dr. K. Goebel. A New Edition of Sachs's "Text-book of Botany," Book II. Authorised English Translation by Henry E. F. Garnsey, M.A. Revised by Prof. I. Bayley Balfour, M.A., M.D., F.R.S. (Oxford: Clarendon Press, 1887.)

ALL botanists who have been familiar, since 1882, with the original of this admirable work, will welcome the present translation, while it will be of even greater value to the large class of students who were unable to make use of the German edition. The full importance of Prof. Goebel's work will only be realised by those who have some acquaintance with the immense progress made in the morphology of plants since 1874, when the last German edition of Sachs's "Text-book" was published. Not a few of the most important of these discoveries are due to Goebel himself, and this fact, no doubt, partly explains the remarkable success with which he accomplished the difficult task of re-writing Sachs's Second Book. Goebel's work is, to all intents and purposes, a new one; but, at the same time, Sachs's own words have been incorporated in the new text in every case where the progress of the science did not actually demand a change.

Important additions to our knowledge have of course been made since the first appearance of this work in Germany. These have been duly recorded, in the English edition, by Prof. Balfour, who has wisely limited the additions to foot-notes. In one or two cases it might, perhaps, have been wished that these notes had been a little fuller.

It will not be without interest to enumerate some of the more striking differences between this work and the corresponding portion of Sachs's treatise. It must not be forgotten that Dr. Vines's revised edition of the latter work had already brought many of these points before English readers.

The same fourfold division of the vegetable kingdom which was adopted by Sachs is maintained here, though it is pointed out that a division into three (Thallophytes, Archegoniatæ, and Angiosperms) would be equally justified. The practical advantages of the former arrangement are obvious. In the classification of the Thallophytes we at once recognise a great advance. The artificial "sexual system," as it has been called, is quite given up, and an arrangement adopted which is based, as far as possible, on the entire life-cycle of the plants in question. Most teachers of botany will already have long abandoned the groups of "Protophyta, Zygosporeæ, Oosporeæ, and Carposporeæ," but it will be an immense gain to students to have a more natural system embodied in a text-book. In Goebel's system we have five main groups. Of these, the first two (Myxomycetes and Diatoms) are kept separate from the rest, on the ground of their uncertain relationships. Then we have the Schizophytes, including the Cyanophyceæ or blue-green Algæ on the one hand, and the Schizomycetes or Bacteria on the other. Then come the two main lines of the Algæ and the Fungi, which are thus again recognised as constituting natural classes, after the separation of the lower groups above mentioned.

The present arrangement is essentially that of De Bary, and no one will doubt that it approximates as nearly to a natural classification as our existing knowledge admits of. The fact that the conditions on which Sachs based his division have been repeatedly shown to vary among the most nearly related plants, is sufficient proof of the necessity for a return to less artificial views. It is to be regretted that no satisfactory place for the Diatoms has yet been found in classification. As regards the Myxomycetes, it will scarcely be doubted that they have no near relationship to any of the higher groups of plants. The fact that the fusion of the plasmodia is not accompanied by a union of their nuclei shows that this process cannot be regarded as a sexual one.

It will be observed that the Yeast-Fungi no longer appear side by side with the Bacteria, but are treated, in accordance with De Bary's views, as reduced Ascomycetes.

In the Algal series, attention may be called to the interesting section on the Volvocineæ, among which the transition from zygosporous to oosporous reproduction can be traced with special clearness. The discoveries relating to Acetabularia, Dasycladus, &c., show that a similar advance has taken place within the very distinct group of the Siphoneæ, while even among the simpler Protococcaceæ indications of an external differentiation between the sexual cells are not wanting. The account of the Phæophyceæ is of special interest from the same point of view, the series from Ectocarpus through Cutleria to Fucus showing the passage from simple conjugation of motile gametes to typical fertilisation of an oosphere by a spermatozoid.

The treatment of the red sea-weeds shows, on the whole, a great advance, though we anticipate still greater changes when the next edition comes to be written. We may venture to express a doubt as to the view here adopted, that the Bangiaceæ are simple forms of the Florideæ. Schmitz has already shown how slight are the grounds on which this arrangement is based. It seems to us probable that a relationship of the Bangiaceæ to the Ulvaceæ may again be recognised in the future, as has already been suggested by Mr. Bennett.

The account of the Characeæ is little modified from that in Sachs, but it will be noticed that they are here treated as oosporous Chlorophyceæ. The question of their systematic position will probably long remain insoluble, but there can be no doubt that they have little in common with any of the carposporous forms of Algæ.

Among the Fungi many changes will be found, of which only one or two can be referred to here. The gradual progress of apogamous degeneration among the Peronosporeæ and Saprolegnieæ, so important for the whole question of sexuality in Fungi, is fully described in the light of De Bary's researches.

Among other points, we may mention the advances in our knowledge of the Lichens, especially of their reproduction, and also the view here adopted, that the Basidio-

mycetes are wholly asexual forms, their so-called fruit representing a complex gonidiophore.

Leaving the Thallophytes, many signs of advance will be found in the description of the Muscineæ. Attention may especially be called to the very clear account now given of the embryology both of the Liverworts and of the true Mosses. In a future edition a fuller account of the vegetative anatomy of the latter class may perhaps be looked for.

In the group of the Vascular Cryptogams the changes have been very numerous. Goebel's view of the essential distinction between the forms in which the sporangium arises from a single cell, and those in which a whole group of cells takes part in its formation, gives the clue to the arrangement here followed. Indeed, there is no part of the book in which the author's own researches have given rise to more important results. The whole subject of the development of the sporangia, both among vascular cryptogams and flowering plants, is one which Goebel has especially made his own.

As regards other points, we may mention that the important subject of apogamy in Ferns is treated at length in the text, while the converse phenomenon of apospory, more recently investigated by Prof. Bower, is dealt with in an editorial note. The embryology of the whole group is treated much more completely than before, and illustrated by new figures. The brilliant discoveries of Treub in the Lycopodiaceæ are shortly recorded in a note, but his most recent work did not appear in time to be noticed.

Going on to the Gymnosperms, we find that the researches of Treub have here led to important advances in our knowledge of the Cycadeæ. The Coniferæ are treated very fully, and here it is more especially to thef labours of Strasburger that the most important progress is due. To him are to be attributed most of the recent discoveries on the development of the macrosporangium and of the prothallus and embryo. It need scarcely be pointed out that these results, in conjunction with the investigations of the author himself, have demonstrated in every detail the homologies between Gymnosperms and Pteridophyta long ago detected by the genius of Hofmeister.

Before leaving the Coniferæ, attention must be called to an error which has, curiously enough, survived through several editions of Sachs's "Text-book," and through both the German and the English versions of the present work. At the middle of p. 337 it is stated that in Juniperus the lowest of the three cells derived from the oospore divides into four cells, each of which gives rise to a rudimentary embryo, so that four rudimentary embryos proceed from one archegonium. At the bottom of the same page we find the following sentence: "But *Picea vulgaris* agrees with *Juniperus*, inasmuch as the lowest of the three primary cells of the suspensor does not divide, but forms only one rudiment." Of these two contradictory statements the former is, of course, the correct one; in the sentence last quoted, *Thuja* should be read for Juniperus.

As regards the Angiosperms, the most considerable changes introduced relate to the development of the stamen on the one hand, and of the ovule and embryo-sac on the other. In the former case it is especially the work of Warming, in the latter that of Strasburger, to which our present knowledge of the facts is due. The treatment of all these subjects by the author of this book is singularly clear. The student will see how the homologies, which were so evident in the case of the Gymnosperms, can also be traced here up to a certain point, while he will also see exactly where our knowledge is still deficient.

The improved account of the embryology of Angiosperms may also be noticed, especially the interesting summary of Strasburger's investigations on polyembryony.

As regards the translation, both Mr. Garnsey and Prof. Balfour may be warmly congratulated on their success. Here and there a slight want of clearness may perhaps be noticed, but this is very rare, and scarcely any errors have been detected. One on p. 17 may, however, be pointed out. It is there stated that in the Myxomycetes "a plasmodium moves away from illuminated spots; if a stronger light is thrown directly upon these spots, a number of plasmodia collect in them." This does not express the fact as stated in the original, which is that, if *the plasmodia* be directly exposed to strong light, they form larger conglomerations. Again, at the top of p. 97, the phrase "*ins Freie*" should scarcely have been translated "into the air," in speaking of a submerged aquatic plant.

The explanation of terms at the end of the book will be of the greatest possible value not only to students but to botanists. We may hope that it will materially contribute to introduce order into the chaos of our terminology. We are glad to see the good old term *spermatozoid* replacing the inaccurate *antherozoid*, and we could wish that ovum could constantly be used for oosphere. Where clear homologies with the animal kingdom can be traced, it seems a distinct loss to ignore them.

On the other hand, we cannot feel satisfied with the word "sporophyte" for the asexual generation in the higher plants. "Sporophyte" is the correlative of "spermaphyte," and has actually been used by Luerssen and others in the sense of a Cryptogam, as distinguished from the seed-bearing Phanerogam. We should have thought that the older terms "sporophore" and "oophore" would answer every purpose.

In conclusion, we can only say that the appearance of this book marks the most important addition to our morphological literature since 1875. D. H. S.

MINERAL PHYSIOLOGY AND PHYSIOGRAPHY

Mineral Physiology and Physiography. A Second Series of Chemical and Geological Essays, with a General Introduction. By Thomas Sterry Hunt, M.A., LL.D. Pp. 688. (Boston: Samuel E. Cassino, 1886.)

THIS work, as its sub-title implies, is a continuation of the series of essays first published by Dr. Sterry Hunt in 1874, of which a second and revised edition appeared in 1878. The essays which make up the present volume have with one exception, that on "The Genetic History of Crystalline Rocks," already appeared in various scientific journals.

The principal title of the work is explained and justified by its author in the two first essays. Dr. Sterry Hunt advocates a return to the older and wider meaning of the term "physiology" as it was employed two

centuries ago; he maintains that all the natural sciences fall into two great divisions, the descriptive or physiographical, and the philosophical or physiological. It seems scarcely necessary to point out that the term physiology is now so universally restricted to the study of the actions of organised beings that any attempt to make it include physics and chemistry, with a large part of geology and astronomy, as the author proposes, can scarcely be expected to meet with much success. In scientific terminology a struggle for existence is continually going on, and it is hopeless to fight against the results of selection: to endeavour at the present day to revive the older and wider meaning of the term "physiology," and to use it as a synonym for "natural philosophy" side by side with the modern and more restricted sense, must almost infallibly lead to confusion. Still more hopeless would it be to try and abolish the use of the term in its present accepted sense.

In the third essay, on "The Chemical and Geological Relations of the Atmosphere," Dr. Sterry Hunt states and defends his well-known speculation concerning the replacement of the carbonic dioxide which is being continually removed from the atmosphere by the processes of kaolinisation and of coal-formation. Rejecting the too obvious suggestion advanced by Stanislas Meunier and others, that the equivalent of the carbonic dioxide abstracted from the atmosphere by the processes in question may be returned to it from subterranean sources, the author insists that such supplies can only come from outside the earth's atmosphere, and must be cosmical in their origin. The fourth essay, following up some of the ideas hinted at in the third, deals with "Celestial Chemistry from the Time of Newton," and is principally occupied with a discussion of the nature of interstellary matter.

The two essays dealing with "The Origin of Crystalline Rocks" and "The Genetic History of the Crystalline Rocks" are devoted to a destructive criticism of various theories which have been propounded to account for the origin of the crystalline schists and gneisses, and the attempt to supply a new one. As is well known, Dr. Sterry Hunt is one of those who maintain that all rocks of this class are necessarily of Archæan age; unlike some of his contemporaries who share the same views, however, he does not shrink from what he believes to be the logical conclusion from these premises, and maintains that the formation of such rocks must result from actions of a very different kind from any now going on upon the globe. According to Dr. Sterry Hunt's idea, which he calls the "crenitic hypothesis," "the crystalline stratiform rocks, as well as many erupted rocks, are supposed to be derived from a primary superficial layer, regarded as the last portion of the globe solidified in cooling from a state of igneous fluidity." After the wonderful speculative flights of these two essays, Dr. Sterry Hunt returns to the ground of sober scientific thought in several essays where ordinary chemists and geologists will not find themselves altogether out of their depth.

The solid contributions made to mineralogical science by the author of these essays may perhaps warrant an attempt on his part to deal with the difficult and involved question of mineralogical classification. This subject he has treated in his essay, "A Natural System of Mineralogy," an elaboration of which is promised in a treatise on mineralogy now in preparation. Dr. Sterry Hunt adopts, as might be anticipated, a purely chemical classification; but his results, which differ in many important particulars from those both of Rammelsberg and Tschermak, do not attract us by their simplicity, and seem perhaps needlessly obscured by the adoption of a very cumbrous terminology.

The essay on "The Geological History of Serpentines" is one in which all the author's peculiar originality and boldness are displayed in their highest perfection. That in the face of the results obtained by the study of rocks with the microscope, anyone could be found to maintain at the present day the *aqueous origin* of many, if not all, serpentines, may seem startling to those who have not read the author's previous writings on the subject. The dexterous gliding over difficult and dangerous places, and the elaborate "figure-cutting" on a few strips of apparently solid ice, constitute one of the most remarkable displays of courage and skill ever exhibited—even by the great mental athlete of Canada himself!

The "Taconic" rocks have formed in North America the battle-ground for two rival schools of geological thought, exactly comparable to that afforded by the Alps to European geologists, and the Scottish Highlands to those of Britain. In the ninth and eleventh essays of the present volume, Dr. Sterry Hunt maintains and stoutly defends his well-known views concerning the origin and succession of the Archæan rocks. For him the most highly foliated schists and gneisses exhibit a stratification clearly due to some kind of sedimentation; in the mineralogical constitution of these rocks he finds evidences of geological age more trustworthy even than those of the organic remains in the later aqueous deposits, and relying implicitly upon this kind of evidence, he has evolved a universal classification for the Archæan deposits which he can apply equally to the rocks of Southern Europe and of British North America. At some of these results persons of less robust faith in Dr. Sterry Hunt's methods can only give way to "admiration," as, for example, when igneous rocks which have been demonstrated to be intrusive in Secondary deposits, are boldly claimed, on account of their mineral characters, as members of some Archæan "system"!

Throughout the present volume, as in the former one, Dr. Sterry Hunt keeps prominently in view his claims to priority, and jealously defends the originality of many of the ideas he puts forward. We cannot but think ourselves that the claim to originality is one which he need take the smallest care to insist upon. If no name had appeared upon the title-page of this remarkable work, every chemist and geologist glancing at its pages would have felt assured that its author could be no other than Dr. Sterry Hunt.

OUR BOOK SHELF

Through the Fields with Linnæus. By Mrs. Florence Caddy. Two Vols. (London: Longmans, Green, and Co., 1887.)

THIS enthusiastic book is the fruit of the author's visit to the land of Linnæus, and her journeys in his track. Its purpose is to tell the story of the life and labours of Linnæus with the local colour so far as it may be restored from contemporary and other records, and from the author's own experiences of travel. We find Linnæus here presented to us

sometimes, as in the story of his early struggles while a student at Upsala, and again at the period of his courtship and his absence from the object of his affections, with the air of the hero of a romance rather than the subject of sober biography. It was to be expected that such periods in his life-history would properly take forcible hold of the sympathies of a lady biographer. It may be said at once that the author has carefully consulted the proper authorities—Stoever, Pulteney, Smith, Jackson, &c., and duly acknowledged her indebtedness to them; and occasionally, with more jubilation than mere complacency, her disregard for them when they fail by disagreement among themselves, or otherwise, to satisfy her. One can hardly say fairer than that. The first impression of the book is unfavourable; in fact, it is felt that one cannot take it seriously. That it is not meant to be so taken altogether is manifest from such statements as that "by Hök rather than by Krök Carl's name was enrolled," &c. Apart from this kind of thing, however, there is often a temptation to smile at the wrong places. The author's observations on men and things in general are frequent and fearless. For example, in discussing an architectural matter she wonders at "the usually perceptive Fergusson" not recognising the significance of a feature well known to ordinary writers on Swedish architecture. Doubtless Mr. Fergusson would have valued this gentle way of describing him, so unlike the manner of those "cock-a-hoop and overbearing young scientific men" whom the author prophesies will be "charming at forty." There is a superabundance too of quotations in the book beyond the legitimate quotations from Linnæus himself and writers of his life. Indeed, to put it in the fashion of that biographer of Linnæus whom she calls "dear old Stoever," she can rarely keep her course clear of the Scylla of her own wisdom and the Charybdis of miscellaneous quotations from Carlyle and a great variety of other writers.

The ancestors of Linnæus, his life from boyhood and school-days, throughout his University career, are discussed with picturesque descriptions of the land and the people. We then come to his *début* in the treatise on the sexes of plants, in answer to Wahlin's "Nuptiæ Arborum Dissertatio." "This," we are told, "was a blooming new idea in the summer of 1730." He is then followed throughout his travels in Lapland, Dalecarlia, his fruitful visits to Holland, England, and France, his return to Sweden and career at home, including his subsequent journeys—to the end. The following passage will give a fair illustration of the style of the more extravagant passages in the book:—

"Linnæus broke down: he dropped like the begonia at the last—the flower that had always interested him so much, with its male and female flowers so graceful and so differing. The common begonia, that most interesting and elegant of plants, is jointed all the way up, and as it withers the joints become separated and in shape like the bones of the human limbs; they drop apart, and fall like dry bones upon the ground. This family is a botanical study in itself. 'Many begonias are remarkable for the production of adventitious buds,'" &c.

In spite of this amazing style it must be owned that apart from such small matters as spelling Linnean, in the name of the Society, "Linnæan," the book is wonderfully correct in the main features of the life of Linnæus, and once the reader is accustomed to absurdities such as we have noted, it becomes a readable narrative. The worst of it is that one is hurried off to somewhere between China and Peru for an illustration of some sober fact, and this without sufficient warning to the unwary reader.

Sur une nouvelle Méthode de faire des Mesures absolues de la Chaleur rayonnante. Par Knut Ångström. (Upsal: Berling, 1886.)

IN this quarto pamphlet of seventeen pages (with a plate) the author claims to give a simple method for determining the absolute measure of radiant heat, and describes a self-registering apparatus which gives the intensity of solar radiation at any instant, as also the total heat received by the absorbing surface in a given time. Two circular copper disks are alternately exposed to the source of heat and screened from it, and a thermo-electric couple and galvanometer give the differences of their temperature. The method consists in finding accurately the average *time* for the *temperature-difference* of the two plates to be a given (small) amount, positive and negative in turns. By the aid of Newton's law of cooling, which is applicable in this case, the author proves that the intensity of the radiation is proportional to the temperature-difference directly, and the time inversely, and that it is quite independent of the constant of cooling. To verify the last conclusion, the author measured with an instrument of this kind the radiation of a constant source of heat under varying conditions of cooling, and he found that the influence of cooling was completely eliminated.

In the construction of the self-registering actinometer founded on this principle, the absorbing surfaces are those of a differential thermometer, and the temperature-differences are marked by the movement of a thread of mercury in the communicating glass tube. When the thread has moved a certain distance, corresponding to a known temperature-difference in the two bulbs, an electric circuit is completed, and an electro-magnet turns the instrument through 180°, thus reversing the positions of the screened and unscreened bulbs. By the usual clock-driven pencil and revolving cylinder, a curve is drawn of which the abscissa is proportional to the time, and the ordinate to the number of turns which the instrument has made in the time. It is then shown that at any instant the intensity of the radiation is proportional to the tangent of the angle which the curve makes with the axis of abscissæ, and that the total heat received in a given time is proportional to the difference of the ordinates corresponding to the beginning and end of the time. The constants by which these variables are to be multiplied must be found by comparison with an absolute instrument like that already mentioned, and the necessity for this comparison may prove an obstacle to the general use of the instrument. Notwithstanding this drawback, the author claims for his invention that it gives results in accordance with those of the absolute instrument, and that it works as satisfactorily on stormy days as on calm ones. There is no doubt that the instrument is deserving of a fair trial, and a comparison of the results obtained from it and from some other recent forms of actinometer, would be of great value.

The paper is carefully written and printed, and we have noticed only two unimportant slips: one on p. 9, last line but one, where 40·0 should be 41·0; and another on p. 16, line 9, where *plus* should be *moins*.

T. H. C.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to insure the appearance even of communications containing interesting and novel facts.*]

Vitality and its Definition

WHILE warmly congratulating Prof. Judd upon the ability with which he has brought "out into clear relief the analogies between the science dealing with the mineral kingdom and those concerned with the animal and vegetable kingdoms," I cannot but think he has a little understated the difference between organic and inorganic matter. As this has arisen from a misconception of Mr. Spencer's definition of life—a misconception

which has previously come before my notice in cases where other minds have looked at this same question—I venture to think you will allow me a few lines to show from what it arises, in the hope of expounding a subject which, popularly understood, must undoubtedly appear a little complex.

If, instead of taking the "concrete equivalent" of the definition, which the Professor has taken, though it is only used in the original "for our present purpose," we take "the broadest and most complete definition of life," . . . "*the continuous adjustment of internal relations to external relations*" ("Principles of Biology," vol. i. p. 80), we shall find that the changes undergone by minerals, even the physiological changes, will not obviously come within it; for it appears to me that, in the illustrations named in last week's NATURE, the minerals only display a continuous adjustment of internal *changes* to external *changes*. A change in the incident forces produces a change in the internal molecular arrangement of the mineral; a further change in the forces is *followed* by a further molecular, or molar, rearrangement in the mineral, and so on. There is no *anticipatory*, or *induced, change*—this is the point—in the mineral, which will correspond with the change which usually is connected with, and is sequent upon, the first environmental change, as is the case with living organisms. A quotation from the "Principles of Biology" (vol. i. p. 79) in conclusion will, I hope, now make my meaning clear. "If a creature's rate of assimilation is increased in consequence of a decrease of temperature in the environment; it is that the *relation* between the food consumed and heat produced, is so re-adjusted by multiplying both its members, that the altered *relation* in the surrounding medium between the quantity of heat absorbed from, and radiated to, bodies of a given temperature, is counterbalanced. If a sound or a scent wafted to it on the breeze, prompts the stag to dart away from the deer-stalker; it is that there exists in its neighbourhood a *relation* between a certain sensible property and certain actions dangerous to the stag, while in its organism there exists an adapted *relation* between the impression this sensible property produces, and the actions by which danger is escaped." The importance attaching to the word *relation* in this quotation has led me to emphasise it by italics.

Churchfield, Edgbaston F. HOWARD COLLINS

Oldhamia

PROF. SOLLAS's ingenious suggestion as to the origin of *Oldhamia* (NATURE, p. 515; Proc. R.D.S. p. 355) undoubtedly deserves very careful consideration; but it appears to me to leave some serious difficulties unexplained. For instance, the following occur to me after reading his paper and after examining two very fine specimens—one of *O. antiqua*, the other of *O. radiata*—recently placed in my hands by Mr. R. H. Scott, F.R.S.:—(1) The "puckerings," which are supposed to simulate the organism, are more definite in their boundaries than is usually the case with the ridgy or wavy "rucking up" which often occurs in phyllites as a first stage in the production of *Ausweichungsclivage*. (2) While I can trace down into the mass of the slate a certain puckering, I am at present unable to connect it with the *Oldhamia* visible on the upper surface. (3) As Prof. Sollas himself remarks, it is difficult to account for the peculiar branching form of *Oldhamia*. As it happens, during the last two or three years I have seen many examples of puckered phyllites, but never met with anything like *Oldhamia*. This difficulty in the case of *O. antiqua* seems to me almost insuperable. (4) In some cases I can detect two sets of markings crossing one another, so that the surface of the stone shows a reticulate structure, one set of lines being less definite than the other. This looks very much as if one branch of an organism were lying on the top of another; but I cannot account for it by mechanical movements alone. (5) The constancy of character in the markings is also a difficulty. One would expect every stage of development from the least to the most imitative. Now, though the *Oldhamia* is often indistinct, it certainly seems to me more like bad preservation than imperfect development of a structure.

Of course I do not in the least question the accuracy of the observations made by Mr. Teall and Prof. Sollas on the structure of the Bray Head rock; I only doubt whether the relation of this to *Oldhamia* can be regarded as proved. However, I am having some slides prepared from the above-named specimens, and hope that they may help in solving my difficulties.

23 Denning Road, N.W., April 5 T. G. BONNEY

Disappearance of Bishop's Ring in Colorado

THE reddish ring about the sun first distinctly appeared here (at the base of Pike's Peak) on November 22, 1883. For several days before that date, a faint discoloration of the region about the sun had attracted my attention. This gradually grew more intense, and, on the day mentioned, became unmistakable. The subsequent history of Bishop's ring as seen at this place is, in brief, as follows:—

The colour was most intense during the winter of 1883–84, and diminished in brightness from that time until its disappearance. At first it was visible almost all the time. Later, it appeared only at the time of cold storms, which were accompanied by great vertical movement of the air, or when, for any reason, the clouds reached to a great height. It was, on the average, brighter during the winters than in the summers; also, it was brighter when the sun was near the horizon. Many times in cold weather there has been not a trace of the ring, although the air was so clear that peaks a hundred miles distant were distinctly visible from the heights behind this city. At other times the ring has been very bright when the air was so hazy that the mountains only ten miles away were hardly visible. During the later months of 1885 it was invisible most of the time, but suddenly flamed out in wonderful intensity at the time of the great norther of January 9–11, 1886. Then for about two months it frequently appeared in the morning, or towards evening. During the warm months of 1886 it was not seen. On October 15 it appeared distinctly. About a week later it appeared very faintly a few times, and since then I have not been able to see a trace of it. My observations have been made at elevations of from 6000 to about 13,000 feet, and there was but little apparent difference in intensity at the different elevations. It is well known that the atmosphere here is, in general, very dry and transparent.

The diffraction-ring was often more coppery, almost rosy, in tint at the time of the northers, and in the thickening haze in the upper air preparatory to hailstorms. The great intensity of the colour at such times, and its peculiar tint, and that, too, irrespective of the amount of haze in the lower atmosphere, makes it probable that the ring was in part due to diffraction on ice-particles. If so, the ice-particles may themselves have been due to precipitation on dust-particles. The fact that no diffraction-ring has been seen around the sun during the past winter is not conclusive, for we have had no great northers, the season being unusually mild. But the disappearance of Bishop's ring for so long a time makes it certain that, even if there can be a circum-solar glow due to diffraction on ice-particles, yet the proper conditions for such a ring are realised only rarely, except when there is a great amount of volcanic dust in the air.

Colorado College, Colorado Springs G. H. STONE

Iridescent Clouds

SEVERAL brilliant displays of iridescent clouds have appeared here during the past winter. One, on January 19, lasted for more than two hours during a "Chinook" wind. A mass of closely-connected cirro-cumulus clouds formed at a great elevation directly over the eastern base of the Rocky Mountains, and thence extended eastward as far as the eye could reach. The western sky was clear. As the clouds drifted slowly eastward, new clouds formed along their western border. The western limit of the clouds was for several hours nearly stationary, then slowly advanced westward opposite the direction of cloud-motion. Along the western border of the clouds were many projecting tongues of cloud. At one time I counted seven complete spectra at the thinner parts of the clouds—all showing bands of red, green, and violet. There were also about twenty-five spectra showing only one or two of the colours. The larger of these iridescent spots were about 10° in diameter, and they varied in distance from 5° to more than 45° from the sun. Their tints were intensely brilliant. There were also great numbers of minute iridescent spots where the colours were in great confusion—a phenomenon which is very common here. They sometimes are so numerous as to simulate Bishop's ring.

Colorado Springs, Colorado G. H. STONE

A Claim of Priority

IN connexion with the letter of M. Ventosa headed as above in your issue of March 31 (p. 513), I should be glad if you would let me refer to a note which was appended to my paper

on "Continuous Calculating Machines," in the Philosophical Transactions of the Royal Society, part ii., 1885.

This note, whilst giving due priority to M. Ventosa in the matter of *one* of the two features of the sphere and roller integrator, described in the above paper, a feature at which I need scarcely say I arrived quite independently, points to the fact that this forms but a part of the integrator in question. When combined with the other portion, that integrator is a calculating machine in the widest sense of the term. I have shown that in addition to giving the value of

$$\int y dx,$$

where y is any linear function of x, other varieties of the mechanism obtain the value of such expressions as

$$\int F_1(x) F_2(x) \ . \ . \ . \ F_n(x) dx,$$

and

$$\int\int \phi(x, \ y) dy dx,$$

and also by a converse process give approximately the value at any instant of R where

$$R = \frac{dy}{dx}.$$

I had not before to-day seen the paper of Mr. F. J. Smith in the *Phil. Mag.* (August 1886), referred to by M. Ventosa. On pp. 381 and 382 of my paper above alluded to will be found a description of an integrator which is practically identical with that of Mr. Smith, as I have no doubt he will admit when he reads that description. With that integrator *hollow* brass balls were employed for the very purpose suggested by Mr. Smith. The instrument was, however, abandoned in favour of more convenient forms, one of which was actually employed by that gentleman upon his "ergometer" at the Inventions Exhibition, together with some very ingenious integrators of his own design. There is, I would say, one point of difference between the integrator described by Mr. Smith, and that by myself. The movable arm in the former appears to be guided by a pin in a straight slot. Now in the "sine" form, of which this integrator is an example, this pin should move in the arc of a circle, and it would be interesting to know if approximately correct results have been obtained with what is in some respects a more convenient practical device.

H. S. HELE SHAW

University College, Liverpool, April 9

The Vitality of Mummy Seeds

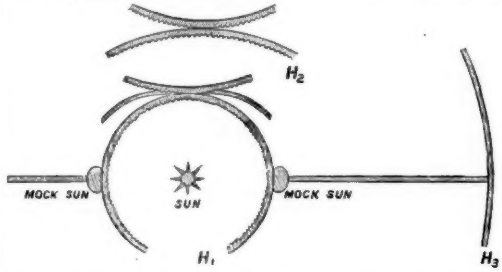
I READ with much surprise in NATURE of March 31 (in Prof. Judd's defence of his statement as to the longevity of seeds) that "competent botanists have cited the case of the germination of seeds taken from ancient Egyptian tombs as authentic." Many experiments have been made as to the length of time seeds may retain their power of germinating, by Robert Brown, Henslow, and others, with interesting results as to the longevity of some; but my impression is, and I venture to make it public, that competent botanists have universally condemned as utterly worthless the evidence given in support of alleged instances of the germination of mummy seeds. No scientifically responsible person has, so far as I am aware, put the fact on record. In these circumstances, therefore, the results of the successful experiments referred to farther on by Prof. Judd as having recently been made, possess the greatest interest, and botanists will look forward eagerly to the details which it is to be hoped will soon be made public. Hitherto the fruitful source of error has been the deception at the outset of the credulous experimenter by the Arab. In fact, the mummy wheat of one well-known traveller grew up in the form of *oats*—a plant not cultivated by the ancient Egyptians, but now grown in the land they inhabited—though this did not shake his faith in the genuine source of his supply. In the present case, however, the statement made in faith by so high an authority as Prof. Judd leads us to anticipate that the undertaking has been hedged in with all the safeguards demanded by a pure cultivation of undoubtedly genuine material.

GEORGE MURRAY

7 Onslow Place, South Kensington, S.W., April 5

Solar Halos

IN the forenoon of March 6 the sun was surrounded by a series of halos of the form shown in the diagram. The side of each arc, marked with a wavy or saw-toothed outline, was red, and the opposite edge blue; but no colour at all was visible in the horizontal belt nor in the farthest-out halo (H_3). This sketch shows the appearance at about 9 a.m.; as the sun rose higher, the horizontal belt got a curve upwards at each side—*i.e.* it continued to be parallel to the horizon—and was prolonged inside H_1 till it almost touched the sun. The two mock-suns



were distinctly on the outside of H_1, and were coloured red next the sun, and blue outside, their reds about coinciding with the blue of H_1. The following are some of the measurements:—

Sun to western mock-sun	23° 46′
,, eastern ,, ...	23 42
,, H_3 (two measurements)...	79 56 / 81 23

The halo H_3 has, I believe, been very seldom seen, and there are only three estimates of its radius on record: two of these make it 90°, and the third makes it 85° to 90°. It will be seen that our measurements—both about 81°—are considerably less than any of the former ones.

R. T. OMOND

Ben Nevis Observatory

On the Character of the Beds of Chert in the Carboniferous Limestone of Yorkshire

IT may be of interest to geologists to know that I have lately ascertained that the beds of chert which occur in the limestones of the Yoredale series of Yorkshire are distinctly of organic origin, and that, in fact, they are composed of the heterogeneously-mingled spicules of disintegrated siliceous sponges. The beds vary from 3 inches to 18 feet in thickness, and the limestones in which they are interbedded are nearly exclusively composed of the broken-up remains of crinoids, thus showing a well-marked alternation of periods in which sponges and crinoids succeeded each other. The spicules can only be studied in thin microscopic sections of the rock; in some cases they are very perfectly preserved and their axial canals are clearly shown; in other examples only very faint outlines can be made out. They appear to belong for the most part to the same group of Hexactinellid sponges as the recent genus *Hyalonema*, but Monactinellid spicules, like those of the existing genus *Reniera*, are also very numerous in some of the beds. Such an enormous accumulation of the debris of siliceous sponges proves that these organisms were as abundant in the Carboniferous as in the Cretaceous seas.

The beds of chert referred to are exposed near Harrogate, and at Richmond, Yorkshire, and they are remarkably developed at Arkendale, about fourteen miles above Richmond. I am indebted to Mr. J. G. Goodchild, of the Geological Survey, for directing my attention to this last-named locality. Owing to their resistant character, fragments of the beds are also widely distributed in the boulder-clays to the south of their outcrops, and I have met with them in these clays near York.

It has been known for some time that the remains of siliceous sponges are of common occurrence in the Carboniferous chert beds of Ayrshire and of certain parts of Ireland, but they do not appear to have been noticed hitherto in the corresponding beds of Yorkshire. I hope shortly to give a more detailed description of their principal characters.

GEORGE J. HINDE

Croydon, April 2

The Zirconia Oxy-hydrogen Light

I HAVE been interested in the brief note you gave upon Prof. Linnemann's zirconia light, and as I have for several years been endeavouring to obtain the alleged advantages of this earth as a luminant, and with very different comparative results, if you will allow me briefly to state these, it may possibly be of service. Zirconia has been stated by Du Motay to be the "most luminous" as well as most refractory of earths, and if it indeed be so, its advantages would be very great. I have made many fruitless attempts to procure one of Du Motay's own pencils as prepared and sold many years ago, but none seem now obtainable; if any reader possesses, and can lend me, one for trial (all the better if he can share in or witness it), I shall be exceedingly obliged, in the interests of improved optical projection.

With the assistance of Mr. Chadwick, of Manchester, Mr. H. G. Madan, of Eton College, and a third gentleman, of Leeds, my own experiments have been made with small cylinders about 9 millimetres diameter, compressed from three different samples of zirconia. The incandescent surface was the flat end of such a cylinder.

The first sample was sold as "pure" by Hopkin and Williams, and many cylinders were tried of it. It was very largely contaminated with soda, which might in time have volatilised; but a more hopeless impurity was the large quantity of silica, which quickly fused into a thick yellow glaze. The light was most inferior, but the reddish tinge presently noticed was *not* conspicuous in this sample, which was worthless as an illuminant.

The second sample was prepared by my Leeds colleague, largely by blow-pipe processes. It stood the flame much better, and contained far less soda, which rapidly lessened under the flame. It contained, however, considerable silica, which could be observed through dark glasses to seethe and melt into ridges. When this took place, the light rapidly diminished, and was never near that of a lime cylinder, though at one time respectable. Also, fissures appeared in the face. But the peculiar physical properties of the earth were conspicuous, and chiefly its extraordinary *non-conducting* power. With a powerful jet (capable of yielding 700 candle-power on a lime cylinder) playing upon the small surface described, the full incandescence barely reached the edge of the disk, and the bright portion only extended about $2\frac{1}{2}$ millimetres up the cylinder, bounded by a definite line. At this line a crack all round began to appear, which gradually deepened, until at length the incandescent layer separated and fell off. The glow was of a most pronounced *reddish* character.

The third sample was procured by Mr. Madan from Herr Schuchardt, of Görlitz; it is stated to be prepared "especially" for the oxy-hydrogen light, and is sold at the rate of 18 marks for 10 grammes, of which about half is required to form a cylinder. This sample shrank enormously when heated, both in powder and when first compressed—showing that it was very largely hydrated—and had to be re-crushed and compressed again before anything could be done with it. It was much more free from silica, and half an hour of a powerful jet only produced a slight glaze or polish on the face. The *reddish* glow was very prominent in it also. The most serious fault, or difficulty, was that the circular crack formed and deepened much more rapidly than in the preceding, and the layer separated in less than half an hour. I fear this unequal shrinkage and its effects will alone be a great obstacle, unless—which I much regret we did not test experimentally—the thin layer itself, as detached, should prove sufficient, held in a platinum loop. Possibly it might crack no further.

But the light was again *poor* compared with a good lime. Mr. Madan had the plug crushed and re-made, and tested the light photometrically in his own laboratory at Eton. Compared with a good quarry lime, the zirconia taken as unity was only 1 : 2·88, with the same jet. That is a very startling difference. It is true that the incandescent surfaces are probably in about the same proportion, so that the brilliancy *per unit of surface* may be about the same. But then the incandescent surface of the zirconia cannot be increased, owing to the non-conducting properties already alluded to; so that the fact remains, so far as illumination is concerned, that we can only get with zirconia, or with such samples as I was able to obtain, about *one-third* of the light we can get from a good lime.

This result is so different from that stated by Prof. Linnemann, and years ago by Du Motay, that some explanation seems necessary. I think it lies in the fact that Continental operators do not use nearly such powerful jets as are often used in England, where we obtain 600 to 700 candle-power. Several Continental jets have come into my hands, none of which would give a good light, as a first-class "magic-lantern" lecturer understands it, *i.e.* sufficient to illuminate a disk 25 feet in diameter. Prof. Linnemann's own jet, of which I have seen the drawings, though it has the useful property of condensing the heat into a very small spot, is only a form of the "blow-through," as usually called; and when he remarks upon the "unsteadiness" of the mixing jet, he shows that he is not practically acquainted with it in a good form. Again, I was given by Mr. W G. Lettsom some time ago a sample of an "improved" composition sold in Germany instead of limes, and stated to be "much better" for oxy-hydrogen purposes; my jets simply burnt holes clean through it (a prism of about 18 mm. diameter) in less than a minute. Now it is noticeable that with a blow-through jet, of about 200 candle-power, the zirconia does compare much more favourably, and is about as bright as the lime.

I write this, however, with a last hope of getting "more light" on the subject. If we could only get the whole light of a good lime-cylinder into the small disk (which is all that can be heated) of zirconia, the advantage would be very great: the parallel or other beam from the lantern from such a radiant is *as sharp* as from an arc light, and every Professor knows what that means. 700 candle-power without trouble—who does not long for it? It will be observed that each of the three samples described behaved differently, and it is in this fact lies my chief hope of any success yet; otherwise it is the decided opinion of all who have shared in these experiments, that the vaunted zirconia light is a sheer delusion. If any reader of these columns knows of purer samples to be procured commercially (I know Draper's process, but am no practical chemist, and have neither time nor means to prepare samples myself); or can tell me if the peculiar *red glow* noticed is characteristic of the earth itself or of some impurity; or has tested lanthana or any other of the more refractory earths; or can in any way assist me in what is, in its way, a matter of some importance to the science lecture-room, I shall feel much obliged for any communication from him, either here, or to LEWIS WRIGHT

7 Beaumont Road, Hornsey Rise, N.

The Production of Newton's Rings by Plane Soap-Films

LORD RAYLEIGH, in his recent lecture at the Royal Institution on "The Colours of Thin Plates," introduced Sir D. Brewster's experiment, in which circular rings instead of the usual straight bands are produced in a vertical soap-film by causing a jet of air to impinge very obliquely upon the film near its edge. The particles are thus thrown into a vortex-motion, and the centrifugal tendency causes the film to become thinner at the centre than at the edge, so as to produce very fair rings of colour.

Perhaps it may be worth mentioning that the same effect may be produced with greater regularity and less risk to the film, by giving the ring to which it is attached a rapid movement of rotation in its own plane. A shallow brass cup, about 8 or 9 cm. in diameter, the edge of which is turned inwards and rounded so as to give it the following section,

is mounted on a horizontal spindle so that it can be turned rapidly in a vertical plane (any ordinary smooth-running multiplying-wheel arrangement will answer, but a small electromotor is by far the most convenient). The edge of the cup is just dipped below the surface of the soap-solution, and then the socket at the back is fitted on the spindle and rotation commenced. At first the straight horizontal bands of colour maintain their form and position, for the reason which Lord Rayleigh well explained; but, as the speed increases, the adhesion of the film to the edge of the cup, and the cohesion of its particles, cause it to take up gradually the motion of the cup; and, as the mass accumulates at the circumference, very perfect circular rings are formed, which can be projected with brilliancy on a screen by the lime-light. H. G. MADAN

Eton College

Barnard's Second Comet

THERE would appear to be some danger that the observation of the above comet may be relinquished rather prematurely, as

it is still sufficiently bright for observation when viewed with our larger telescopes; and, as far as I am aware, there are no published ephemerides later than March 27. To remedy this want, I subjoin places calculated from the elements of Dr. Palisa for Greenwich mean midnight for the period during which the moon will be absent.

	R.A. h. m. s.	Decl. ° ′	Log *r*
April 13	2 52 34	+36 54·6	0·0183
„ 15	2 51 2	+37 3·2	0·0222
„ 17	2 49 36	+37 12·3	0·0265
„ 19	2 48 12	+37 20·6	0·0311
„ 21	2 46 52	+37 28·6	0·0360
„ 23	2 45 35	+37 36·4	0·0412

JOHN I. PLUMMER

Orwell Park Observatory, April 11

Sunspots

IN the summary in regard to solar activity in 1886, published in NATURE for March 10, p. 445, it is stated that, during the period from October 31 to December 12, "on six days only out of the forty-two could there be discovered on the sun any trace even of a spot, and on those days only one tiny spot could be seen." As observed in this locality, there were formed, in the midst of the faculæ which came into view on November 14, one spot on November 15 and two spots on November 16; all having disappeared on November 18, when observation again became possible. On December 8 the first of a group of spots which made a complete transit across the sun's surface appeared. On December 9 this group consisted of three spots, which persisted until the 13th at least, gradually increasing in size. A period of sunspot minimum is best adapted in certain regards to the study of the relations of solar outbursts to magnetic and auroral phenomena; hence precision at such times, in reference to details of the character here indicated, is not unimportant.

Lyons, N.Y., March 30 M. A. VEEDER

Ozone

MY attention has been drawn to a letter in your issue of January 13 (p. 248), respecting the production of ozonised air for respiration in pulmonary complaints. I beg to inform "W. H." that there is at present no convenient electrical apparatus devised for use in a room, that would electrify the air with sufficient power to be of much service. A simple plan for obtaining ozone in small quantities is to mix very gradually three parts of strong sulphuric acid with two parts of permanganate of potash in a jam-pot, and place the vessel under the bed. Ozone will be given off from this mixture for some weeks.

I should be glad to hear the experiences of "W. H." inhaling ozonised air "just sensible to the smell," as I am of opinion that this strength of ozone is rather too great.

Your correspondent is misled in supposing that the Engadine hotels possess appliances for ozonising the air of corridors, &c. It is only the Maloja Kursaal which has adopted my device for this purpose. The electric current used is taken off from one of the dynamos used for lighting. A short description of the plan is given in the third edition of my "Alpine Winter," p. 84.

Upper Engadine A. TUCKER WISE

Electrical Discharges in the Doldrums

I QUITE agree with the Hon. Ralph Abercromby as to the continuous electrical discharges in the doldrums; so is there a continuous discharge of rain. I do not, however, agree with him in thinking that the electrical discharges are in any way directly connected with earth-currents. I should say they are due to electrical discharges on the top of the shower clouds, unaccompanied by thunder. It would be interesting to know if travellers in the centres of Africa and South America have observed this phenomenon there.

DAVID WILSON-BARKER

Green Light at Sunrise and Sunset

MR. R. T. OMOND, of the Ben Nevis Observatory, in NATURE of February 24, p. 391, asks whether the cause of the green colour at sunset at sea is the sun shining *through* the water? This cannot be the cause, for I have many times observed this colour at sunrise behind the mountains Madonie or Copo Zaferano, which, from the Observatory, appear higher on the sea horizon than the sun's disk. That is to say, the phenomenon occurs when, for the observer, the sun is entirely above the marine horizon, and no part of the disk can shine through the water.

A. RICCÒ

Palermo Observatory

[This is a well known and obvious effect of atmospheric refraction.—ED.]

A Sparrow chasing Pigeons

"E. A. C." inquires in NATURE of last week (p. 536), whether any of your readers have observed the sparrow chasing pigeons. This habit of the sparrow is very common; I have myself often observed it, and I apprehend that few who keep pigeons have not frequently seen such attacks. The pugnacity of the sparrow did not appear to me to be the result of any previous quarrel with the pigeon, as I never saw the former attack the latter except on the wing, and always from underneath.

Chirbury, Beckenham, Kent, April 12 J. JENNER WEIR

A Question for Chemists

Is it known that a mixture of glycerine and permanganate of potassium will take fire spontaneously immediately after being mixed? If so, I should be glad of any reference to the fact.

Bradford WM. WEST

THE PARIS ASTRONOMICAL CONGRESS

THE International Congress called together by the French Government to take steps to obtain a photographic chart of the heavens was opened on Saturday at the Observatory of Paris, and, from the information which has reached us so far, it would seem that its labours are likely to have a result of the highest importance for the science of this and succeeding centuries. The following Directors of Observatories are already in Paris, or are expected: if half of them really come, there will be such a meeting of astronomers as has rarely been seen:—

Baillaud, Toulouse Observatory
Bakhuyzen, Leiden
Beuf, La Plata
Christie, Greenwich
Cruls, Rio de Janeiro
Donner, Helsingfors
Dunér, Lund
Folie, Brussels
Gill, Cape Town
Gyldèn, Stockholm
Krueger, Kiel
Oom, Lisbon
Perry, Stonyhurst
Peters, Clinton (U.S.A.)
Pujazon, San Fernando
Rayet, Bordeaux
Russell, Sydney
Schoenfeld, Bonn
Struve, Pulkowa
Tacchini, Rome
Thiele, Copenhagen
Trépied, Algiers
Vogel, Potsdam
Weiss, Vienna

Besides these Directors of Observatories, and of course all the astronomical members of the Institute, there are other astronomers, such as Messrs. Common and Roberts from our own country, and Messrs. Lohse (from Germany), Winterhalter (from Washington), and Hasselberg (from Pulkowa), whose presence is most important.

The French Government, the Academy of Sciences (with Dr. Janssen as President), and Admiral Mouchez (the Director of the National Observatory of Paris), seem to have done all in their power to facilitate the labours, and even to provide for the comfort, of the various delegates and others representing the various nationalities; and at the opening ceremony the manner in which the Institute and Government are doing all they can was evidenced by the fact that the address which was delivered by M. Bertrand, the eminent mathematician, on behalf of

the Academy of Sciences, was followed by another, made by M. Flourens, the Minister of Foreign Affairs.

They certainly manage these things better in France! Fancy a scientific meeting at Greenwich Observatory, addressed by the head of the English Foreign Office!

What M. Flourens said had better be given in his own words:—

Messieurs,—

J'ai l'honneur de vous souhaiter la bienvenue au nom de la France, qui vous offre ici sa cordiale hospitalité.

Je me félicite que cette mission me soit échue de vous complimenter au nom du gouvernement de la République, de vous remercier d'avoir accepté les invitations qui vous ont été adressées par l'éminent et sympathique directeur de notre Observatoire.

C'est une grande œuvre que celle que vous allez entreprendre, et, grâce aux lumières que vous nous apportez de tous les points du globe, mener à bonne fin. Dans la poursuite de cette œuvre, vous aurez, je n'en doute pas, l'appui de tous les gouvernements, qui sont animés aujourd'hui d'une noble émulation pour le développement de la science. En tout cas, le concours du gouvernement de la République française, au nom de laquelle j'ai l'honneur de parler, vous est dès à présent acquis.

Vous allez, dans une féconde et cordiale entente, jeter les bases de l'exécution d'une carte du ciel dont la précision dépassera de beaucoup non seulement tout ce que l'on avait réalisé, mais encore tout ce que l'on avait osé rêver jusqu'à ce jour. Par une merveilleuse application de la photographie, de cet art si riche en résultats imprévus, vous allez diriger l'œil humain dans des profondeurs où, à l'aide des plus puissants télescopes, on n'avait pas cru possible de le faire pénétrer. Le nombre des étoiles inconnues jusqu'ici, dont l'existence sera ainsi révélée, est incalculable.

Ce sera pour votre nom, messieurs, une gloire éternelle d'avoir apporté votre précieuse collaboration à l'inauguration de cette grande entreprise, et le jour de l'ouverture de ce congrès marquera dans les annales de la science humaine.

Une ère nouvelle s'ouvre pour l'astronomie physique comme pour l'astronomie mathématique, qui vont avoir à leur disposition un moyen d'investigation, de contrôle, de précision qui étendra dans une proportion indéfinie la fécondité de leurs recherches. Vous allez écrire la première page authentique des transformations et des modifications de la matière cosmique, c'est-à-dire l'histoire de l'univers lui-même.

Je voudrais complimenter, par leurs noms et par leurs œuvres, chacun des savants illustres qui sont réunis dans cette enceinte. Mais j'abuserais des précieux et trop courts instants de notre réunion. Nos hôtes trouveront bon que je les honore tous en la personne de leur doyen, de l'illustre M. Struve, dont le nom est si sympathique à la France et dont on fêtait naguère le vingt-cinquième anniversaire comme directeur du célèbre observatoire de Poulkova.

Agréez, messieurs, avec mes vœux les plus sincères pour la réussite de vos efforts, la nouvelle assurance du concours du gouvernement de la République.

Prof. O. von Struve replied to this address in a short and impressive speech, and the Conference proceeded to elect officers.

Admiral Mouchez, the Director of the Observatory, was elected Honorary President, and Prof. O. von Struve Acting President. As Vice-Presidents, Messrs. Auwers, Christie, and Fizeau were elected; as Secretaries, Messrs. Tisserand and Bakhuyzen, assisted by Dunér and Trépied.

The Conference then proceeded to pass the following resolutions:—

(1) The progress realised in astronomical photography renders it absolutely necessary that the astronomers of the present century should undertake a conjoint photographic record of the heavens.

(2) This work shall be undertaken at certain stations to be selected, and with instruments identical in all essential points.

(3) The principal objects sought to be attained shall be:—

(*a*) To record the general state of the heavens at the present time by obtaining data which will enable us to determine the position and brilliancy of all the stars down to a certain magnitude, to be hereafter agreed on, with the greatest precision possible; the magnitudes to be expressed according to some photographic standard to be hereafter determined.

(*b*) To fix upon the best means to utilise at the present time the various data furnished by photographic processes.

After these resolutions were passed, the Conference proceeded to appoint a Committee of nineteen members to consider the kind of instrument to be employed, and the lowest magnitude of star it will be necessary to register. The Committee appointed consists of the following astronomers:—MM. Auwers, Bakhuyzen, Christie, Common, Dunér, Fizeau, Gill, Paul Henry, Janssen, Kapteyn, Lœwy, Rayet, Roberts, Peters, O. von Struve, Tacchini, Thiele, Vogel, and Weiss. When this Committee has brought up its Report, the other questions will be considered by a number of Sections, to be appointed to consider and report upon them to the Conference.

Hospitality is not lacking to make the labours of the Conference as light as possible. Admiral Mouchez, who gave a *soirée* on the evening of the 19th, gives a banquet on the 24th. The astronomers are to be received by the President of the Republic, and also at the Théâtre Français by the members of the Institute, on Saturday. There is also to be a ball at the Hôtel Continental, given by Le Comité des Amis de Science.

We warmly congratulate French men of science upon the magnificent results obtained by their countrymen the Brothers Henry, which have been among the causes that have brought the Conference together. If all goes well, the work of the Conference will mark an epoch in the history of astronomy.

HOMERIC ASTRONOMY

I.

THE Homeric ideas regarding the heavenly bodies were of the simplest description. They stood, in fact, very much on the same level with those entertained by the North American Indians, when first brought into European contact. What knowledge there was in them was of that "broken" kind which (in Bacon's phrase) is made up of wonder. Fragments of observation had not even begun to be pieced in one with the other, and so fitted, ill or well, into a whole. In other words, there was no faintest dawning of a celestial science.

But surely, it may be urged, a poet is not bound to be an astronomer. Why should it be assumed that the author (or authors) of the "Iliad" and "Odyssey" possessed information co-extensive on all points with that of his fellow-countrymen? His profession was not science, but song. The argument, however, implies a reflecting backward of the present upon the past. Among unsophisticated peoples, specialists, unless in the matter of drugs or spells, do not exist. The scanty stock of gathered knowledge is held, it might be said, in common. The property of one is the property of all.

More especially of the poet. His power over his hearers depends upon his presenting vividly what they already perceive dimly. It was part of the poetical faculty of the Ithacan bard Phemius that he "knew the works of gods and men" ("Od.," i. 338). His special function was to render them famous by his song. What he had heard

concerning them he repeated; adding, of his own, the marshalling skill, the vital touch, by which they were perpetuated. He was no inventor: the actual life of men, with its transfiguring traditions and baffled aspirations, was the material he had to work with. But the life of men was very different then from what it is now. It was lived in closer contact with Nature; it was simpler, more typical, consequently more susceptible of artistic treatment.

It was accordingly looked at and portrayed as a whole; and it is this very *wholeness* which is one of the principal charms of primitive poetry. An irrecoverable charm; for civilisation renders existence a labyrinth of which it too often rejects the clue. In olden times, however, its ways were comparatively straight, and its range limited. It was accordingly capable of being embraced with approximate entirety. Hence the encyclopædic character of the early epics. *Humani nihil alienum.* Whatever men thought, and knew, and did, in that morning of the world when they spontaneously arose, found a place in them.

Now, some scheme of the heavens must always accompany and guide human existence. There is literally no choice for man but to observe the movements, real or apparent, of celestial objects, and to regulate his actions by the measure of time they mete out to him. Nor had he at first any other means of directing his wanderings upon the earth save by regarding theirs in the sky. They are thus to him standards of reference and measurement as regards both the fundamental conditions of his being—time and space.

This intimate connexion, and, still more, the idealising influence of the remote and populous skies, has not been lost upon the poets in any age. It might even be possible to construct a tolerably accurate outline-sketch of the history of astronomy in Europe without travelling outside the limits of their works. But our present concern is with Homer.

To begin with his mode of reckoning time. This was by years, months, days, and hours ("Od.," x. 469, xi. 294). The week of seven days was unknown to him; but in its place we find (in the "Odyssey," xix. 307) the triplicate division of the month used by Hesiod and the later Attics, implying a month of thirty, and a year of 360 days, corrected, doubtless, by some rude process of intercalation. A corresponding apportionment of the hours of night into three watches (as amongst the Jews before the Captivity), and of the hours of day into three periods or stages, prevails in both the "Iliad" and "Odyssey." The seasons of the year, too, were three—spring, summer, and winter—like those of the ancient Egyptians and of our Anglo-Saxon forefathers;[1] for the Homeric *Opora* was not, properly speaking, an autumnal season, but merely an aggravation of summer heat and drought, heralded by the rising of Sirius towards the close of July. It, in fact, strictly matched our "dog-days," the *dies caniculares* of the Romans. This rising of the dog-star is the only indication in the Homeric poems of the use of a stellar calendar such as we meet full-grown in Hesiod's "Works and Days." The same event was the harbinger of the Nile-flood to the Egyptians, serving to mark the opening of their year as well as to correct the estimates of its length.

The annual risings of stars had formerly, in the absence of more accurate means of observation, an importance they no longer possess. Mariners and husbandmen, accustomed to watch, because at the mercy of the heavens, could hardly fail no less to be struck with the successive effacements by, and re-emergences from, the solar beams, of certain well-known stars, as the sun pursued his yearly course amongst them, than to note the epochs of such events. Four stages in these periodical fluctuations of visibility were especially marked by primitive observers. The first perceptible appearance of a star in the dawn was known as its "heliacal rising." This brief glimpse extended gradually as the star increased its seeming distance from the sun, the interval of precedence in rising lengthening by nearly four minutes each morning. At the end of close upon six months occurred its "acronychal rising," or last visible ascent from the eastern horizon after sunset. Its conspicuousness was then at the maximum, the whole of the dark hours being available for its shining. To these two epochs of rising succeeded and corresponded two epochs of setting—the "cosmical" and the "heliacal." A star set cosmically when, for the first time each year, it reached the horizon long enough before break of day to be still distinguishable; it set heliacally on the last evening when its rays still detached themselves from the background of illuminated western sky, before getting finally immersed in twilight. The round began again when the star had arrived sufficiently far on the other side of the sun to show in the morning—in other words, to rise heliacally.

Wide plains and clear skies gave opportunities for closely and continually observing these successive moments in the revolving relations of sun and stars, which were soon found to afford a very accurate index to the changes of the seasons. By them, for the most part, Hesiod's prescriptions for navigation and agriculture are timed; and although Homer, in conformity with the nature of his subject, is less precise, he was still fully aware of the association.

His sun is a god—Helios—as yet unidentified with Apollo, who wears his solar attributes unconsciously. Helios is also known as Hyperion, "he who walks on high," and Elector, the "shining one." Voluntarily he pursues his daily course in the sky, and voluntarily he sinks to rest in the ocean-stream. Subject, however, at times to a higher compulsion. For, just after the rescue of the body of Patroclus, Here favours her Achaian clients by precipitating at a critical juncture the descent of a still unwearied and unwilling luminary ("Iliad," xviii. 239). On another occasion, however, Helios memorably asserts his independence, when, incensed at the slaughter of his sacred cattle by the self-doomed companions of Ulysses, he threatens to "descend into Hades, and shine among the dead" ("Od.," xii. 383). And Zeus, in promising the required satisfaction, virtually admits his power to abdicate his office as illuminator of gods and men.

Once only, the solstice is alluded to in Homeric verse. The swineherd Eumæus, in describing the situation of his native place, the Island of Syrie, states that it is over against Ortygia (Delos), "where are the turning-places of the sun" ("Od.," xv. 404). The phrase probably indicates the direction in which Delos lay from Ithaca, being just so much south of east as the sun lies at rising on the shortest day of winter. To those early students of Nature, the travelling to and fro of the points of sunrise and sunset, furnished the most obvious clue to the yearly solar revolution; so that an expression, to us somewhat recondite, conveyed a direct and unmistakable meaning to hearers whose narrow acquaintance with the phenomena of the heavens was vivified by immediate personal experience of them.

Selene first takes rank as a divine personage in the Homeric hymns. No moon-goddess is recognised in the "Iliad" or "Odyssey." Nor does the orbed ruler of "ambrosial night," regarded as a mere light-giver or time-measurer, receive all the attention that might have been expected. A full moon is, however, represented with the other "heavenly signs" on the shield of Achilles, and figures somewhat superfluously in the magnificent passage where the Trojan watch-fires are compared to the stars in a cloudless sky:

"Even as when in heaven the stars about the bright moon shine clear to see, when the air is windless, and all the peaks appear and the tall headlands and glades, and

[1] Lewis, "Astr. of the Ancients," p. 11. Tacitus says of the Germans: "Autumni perinde nomen ac bona ignorantur" ("Germania," cap. xxvi).

from heaven breaketh open the infinite air, and all stars are seen, and the shepherd's heart is glad; even in like multitude between the ships and the streams of Xanthos appeared the watch-fires that the Trojans kindled in front of Ilios." [1]

Here, as elsewhere, the simile no sooner presents itself than the poet's imagination seizes upon and develops it without overmuch regard to the illustrative fitness of its details. The multitudinous effect of a thousand fires blazing together on the plain inevitably suggested the stars. But with the stars came the complete nocturnal scene in its profound and breathless tranquillity. The "rejoicing shepherd," meantime, who was part of it, would have been ill-pleased with the darkness required for the innumerable stellar display first thought of. And since, to the untutored sense, landscape is delightful only so far as it gives promise of utility, brilliant moonlight was added, for his satisfaction and the safety of his flock, as well as for the perfecting of that scenic beauty felt to be deficient where human needs were left uncared for. Just in proportion, however, as rocks, and peaks, and wooded glens appeared distinct, the lesser lights of heaven, and with them the fundamental idea of the comparison, must have become effaced; and the poet, accordingly, as if with a misgiving that the fervour of his fancy had led him to stray from the rigid line of his purpose, volunteered the assurance that "all the stars were visible"—as, to his mind and eye, they doubtless were.

Of the "vivid planets" thrown in by Pope there is no trace in the original. Nor could there be; since Homer was totally ignorant that such a class of bodies existed. This curious fact affords (if it were needed) conclusive proof of the high antiquity of the Homeric poems. Not the faintest suspicion manifests itself in them that Hesperus, "fairest of all stars set in heaven," is but another aspect of Phosphorus, herald of light upon the earth, "the star that saffron-mantled Dawn cometh after, and spreadeth over the salt sea" ("Iliad," xxiii. 226-27). The identification is said by Diogenes Laertius to have been first made by Pythagoras; and it may at any rate be assumed with some confidence that this elementary piece of astronomical knowledge came to the Greeks from the East, with others of a like nature, in the course of the sixth or seventh century B.C. Astonishing as it seems that they should not have made the discovery for themselves, there is no evidence that they did so. Hesiod appears equally unconscious with Homer of the distinction between "fixed" and "wandering" stars. According to his genealogical information, Phosphorus, like the rest of the stellar multitude, sprang from the union of Astræus with the Dawn ("Theogony," 381), but no hint is given of any generic difference between them.

There is a single passage in the "Iliad," and a parallel one in the "Odyssey," in which the constellations are formally enumerated by name. Hephæstus, we are told, made for the son of Thetis a shield great and strong, whereon, by his exceeding skill, a multitude of objects were figured.

"There wrought he the earth, and the heavens, and the sea, and the unwearying sun, and the moon waxing to the full, and the signs every one wherewith the heavens are crowned, Pleiads, and Hyads, and Orion's might, and the Bear that men call also the Wain, her that turneth in her place, and watcheth Orion, and alone hath no part in the baths of Ocean" ("Iliad," xviii. 483-89).

The corresponding lines in the "Odyssey" occur in the course of describing Ulysses' voyage from the isle of Calypso to the land of the Phæacians. Alone, on the raft he had constructed of Ogygian pine-wood, he sat during seventeen days, "and cunningly guided the craft with the helm; nor did sleep fall upon his eyelids, as he viewed the Pleiads and Boötes, that setteth late, and the Bear, which they likewise call the Wain, which turneth ever in one place, and keepeth watch upon Orion, and alone hath no part in the baths of Ocean" ("Odyssey," v 271-75).

The sailing-directions of the goddess were to keep the Bear always on the left—that is, to steer due east.

It is clear that one of these passages is an adaptation from the other; nor is there reason for hesitation in deciding which was the model. Independently of extrinsic evidence, the verses in the "Iliad" have the strong spontaneous ring of originality, while the Odyssean lines betray excision and interpolation. The "Hyads and Orion's might" are suppressed for the sake of introducing Boötes. Variety was doubtless aimed at in the change; and the conjecture is at least a plausible one, that the added constellation may have been known to the poet of the "Odyssey" (admitting the hypothesis of a divided authorship), though not to the poet of the "Iliad." Known, that is, in the sense that the stars comprising the figure of the celestial Husbandman had not yet, at the time and place of origin of the "Iliad," become separated from the anonymous throng circling in the "murk of night."

The constellation Boötes was invented to drive the Wain, as Arctophylax to guard the Bear, the same group in each case going by a double name For the brightest of the stars thus designated we still preserve the appellation Arcturus (from *arktos*, bear, *oũros*, guardian), first used by Hesiod, who fixed upon its acronychal rising, sixty days after the winter solstice, as the signal for pruning the vines ("Works and Days," 564-70). It is not unlikely that the star received its name long before the constellation was thought of, forming the nucleus of a subsequently formed group. This was undoubtedly the course of events elsewhere; the Great and Little Dogs, for instance, the Twins, and the Eagle (the last with two minute companions) having been individualised as stars previous to their recognition as asterisms.

There is reason to believe that the stars enumerated in the "Iliad" and "Odyssey" constituted the whole of those known by name to the early Greeks. This view is strongly favoured by the identity of the Homeric and Hesiodic stars. It is difficult to believe that, had there been room for choice, the same list *precisely* would have been picked out for presentation in poems so widely diverse in scope and origin as the "Iliad" and "Odyssey" on the one side, and the "Works and Days" on the other. As regards the polar constellations, we have positive proof that none besides Ursa Major had been distinguished. For the statement repeated in both the Homeric epics, that the Bear *alone* was without part in the baths of Ocean, implies, not that the poet veritably ignored the unnumbered stars revolving within the circle traced out round the pole by the seven of the Plough, but that they still remained a nameless crowd, unassociated with any terrestrial object, and therefore attracting no popular observation.

The Greeks, according to a well-attested tradition, made acquaintance with the Lesser Bear through Phœnician communication, of which Thales was the medium Hence the designation of the group as *Phoinike*. Aratus (who versified the prose of Eudoxus) has accordingly two Bears, lying (in sailors' phrase) "heads and points" on the sphere; while he expressly states that the Greeks still (about 270 B.C.) continued to steer by *Helike* (the Twister, Ursa Major), while the expert Phœnicians directed their course by the less mobile *Kynosoura* (Ursa Minor). The absence of any mention of a Pole-star seems at first sight surprising. Even the Iroquois Indians directed their wanderings from of old by the one celestial luminary of which the position remained sensibly invariable (Lafitau, "Mœurs des Sauvages Américains,"

[1] "Iliad," viii. 551-57. Mr. Andrew Lang's admirable prose-versions are employed throughout this article.

p. 240). Yet not the gods themselves, in Homer's time, were aware of such a guide. It must be remembered, however, that the axis of the earth's rotation pointed, 2800 years ago, towards a considerably different part of the heavens from that now met by its imaginary prolongation. The precession of the equinoxes has been at work in the interval, slowly but unremittingly shifting the situation of this point among the stars. Some 600 years before the Great Pyramid was built, it was marked by the close vicinity of the brightest star in the Dragon. But this in the course of ages was left behind by the onward-travelling pole, and further ages elapsed before the star at the tip of the Little Bear's tail approached its present position. Thus the entire millennium before the Christian era may count for an interregnum as regards Pole-stars. Alpha Draconis had ceased to exercise that office; Alruccabah had not yet assumed it.

The most ancient of all the constellations is probably that which Homer distinguishes as never-setting (it then lay much nearer to the pole than it now does). In his time, as in ours, it went by two appellations—the Bear and the Wain. Homer's Bear, however, included the same seven bright stars constituting the Wain, and no more; whereas our Great Bear stretches over a sky-space of which the Wain is only a small part, three of the striding monster's far-apart paws being marked by the three pairs of stars known to the Arabs as the "gazelle's springs." How this extension came about, we can only conjecture; but there is evidence that it was fairly well established when Aratus wrote his description of the constellations. Aratus, however, copied Eudoxus, and Eudoxus used observations made—doubtless by Accad or Chaldean astrologers—above 2000 B.C.[1] We infer, then, that the Babylonian Bear was no other than the modern Ursa Major.

But the primitive asterism—the Seven Rishis of the old Hindus, the Septem Triones of the Latins, the Arktos of Homer—included no more than seven stars. And this is important as regards the origin of the name. For it is impossible to suppose a likeness to any animal suggested by the more restricted group. Scarcely the acquiescent fancy of Polonius could find it "backed like a weasel," or "very like a whale." Yet a weasel or a whale would match the figure equally well with, or better than, a bear. Probably the growing sense of incongruity between the name and the object it signified may have induced the attempt to soften it down by gathering a number of additional stars into a group presenting a distant resemblance to a four-legged monster.

The name of the Bear, this initial difficulty notwithstanding, is prehistoric and quasi-universal. It was traditional amongst the American-Indian tribes, who, however, sensible of the absurdity of attributing a conspicuous protruding tail to an animal almost destitute of such an appendage, turned the three stars composing it into three pursuing hunters.

The same constellation figures, under a divinified aspect, with the title *Otawa*, in the great Finnish epic, the "Kalevala." Now, although there is no certainty as to the original meaning of this word, which has no longer a current application to any terrestrial object, it is impossible not to be struck with its resemblance to the Iroquois term *Okowari*, signifying "bear," both zoologically and astronomically (Lafitau, *op. cit.*, p. 236). The inference seems justified that *Otawa* held the same two meanings, and that the Finns knew the great northern constellation by the name of the old Teutonic king of beasts.

It was (as we have seen) similarly designated on the banks of the Euphrates; and a celestial she-bear, doubtfully referred to in the Rig-Veda, becomes the starting-point of an explanatory legend in the Râmâyana (De Gubernatis, "Zoological Mythology," vol. ii. p. 109).

[1] According to Mr. Proctor's calculation. See R. Brown, "Eridanus: River and Constellation," p. 3.

Thus, circling the globe from the valley of the Ganges to the great lakes of the New World, we find ourselves confronted with the same sign in the northern skies, the relic of some primæval association of ideas, long since extinct.

Extinct even in Homer's time. For the myth of Callisto (first recorded in a lost work by Hesiod) was a subsequent invention—an effect, not a cause—a mere embroidery of Hellenic fancy over a linguistic fact, the true origin of which was lost in the mists of antiquity.

There is, on the other hand, no difficulty in understanding how the Seven Stars obtained their second title of the Wain, or Plough, or Bier. Here we have a plain case of imitative name-giving—a suggestion by resemblance almost as direct as that which established in our skies a Triangle and a Northern Crown. Curiously enough, the individual appellations still current for the stars of the Plough, include a reminiscence of each system of nomenclature—the legendary and the imitative. The brightest of the seven, α Ursæ Majoris, the Pointer nearest the Pole, is designated *Dubhe*, signifying, in Arabic, "bear"; while the title *Benetnasch*—equivalent to *Benât-en-Nasch*, "daughters of the bier"—of the furthest star in the plough-handle, perpetuates the lugubrious fancy, native in Arabia, by which the group figures as a corpse attended by three mourners. A. M. CLERKE

(*To be continued.*)

RAINBAND OBSERVATIONS AT THE BEN NEVIS OBSERVATORY

RAINBAND spectroscopy is one of the extra subjects taken up at the Ben Nevis Observatory, along with the usual meteorological routine. At every hour, when there is sufficient light, the intensity of the rainband is observed and recorded, and now, the mean daily rainband forms one of the items in the Ben Nevis weather report in the daily newspapers. The scale in use is practically the same as that used by Dr. Mill, of the Granton Marine Station, and described by him in a paper to the Royal Society of Edinburgh (Proc. R.S.E., 1882-84). This scale is in the spectrum itself—a great convenience—being the Fraunhofer lines E, *b*, and F of the solar spectrum. After a preliminary set of observations had been made, in various types of weather, for the purpose of determining the relative intensity of these lines, a numerical value was given to each. namely, to E, 2; to *b*, 4; and to F, 7. After a little practice, it is quite easy to estimate the values less than 2, which often occur, and the values above 7, which very seldom occur. With this scale, the intensity or darkness of the rainband and D line taken together is compared, and the numerical value of its scale- equivalent entered in the register. The instrument used is one of Hilger's rainband pocket spectroscopes, and the part of the sky always observed is between 30° and 40° above the south-western horizon.

The results obtained in 1885 were communicated to the Scottish Meteorological Society, and are published in their Journal for 1886 (see NATURE, vol. xxxiii. p. 622). In 1886, over 3000 observations were made, and the relative frequency with which each number of the scale was observed will convey an idea of the intensity of the rainband on Ben Nevis. The percentage of observations of each number is as follows:—

Rainband	0	1	2	3	4	5	6	7
Percentage ...	24	31	27	8	7	1	1	1

The mean of all the observations gives a rainband of 1·7. Now at sea-level, according to Dr. Mill, the rainband is seldom or never less than E, that is, than 2 on our scale. Hence the mean rainband on the Ben is about equal to the minimum at sea-level. About 80 per cent. of these observations were made when the Ben was enveloped in fog or mist. The only effect fog or mist has upon the

rainband is that its intensity is the same in every possible direction, whereas in clear weather, as is well known, it is generally greatest at the horizon and least at the zenith. But as the rainband in fog or mist has been found to be equal to that which is observed in clear weather at an altitude of 30° or 40°—the altitude of that part of sky always observed—the presence or absence of fog and mist has been ignored in working up the observations.

In forecasting the weather for the surrounding low-levels, the rainband observed here, together with similar observations at Fort William, would probably be of great value, but its forecasting power for the summit alone is limited. The lower values generally show indications of rain several hours before it comes on, but the higher values simply indicate a continuation of the heavy rainfall by which they are invariably accompanied. To show that the rainfall increases with the successive numbers of the scale, the mean hourly rainfall has been computed, for each scale value, from the rainfall of the three hours and twelve hours after noon. For the observations of 1885, the mean daily rainband was used. In 1886, each individual observation was taken into account, and, for each number of the scale, the mean rainfall was computed from the rainfall of the three hours after each observation. As the results differ in some respects, they are here given for each year separately :—

Rainband		0	1	2	3	4	5 and upwards
Rainfall (inches)	1885...	·000	·006	·016	·029	·050	·106
	1886...	·002	·006	·012	·016	·027	·076

Owing to the fewness of observations of the numbers 5, 6, and 7, they have been grouped together. The higher values are followed by a rainfall which is proportionally far too high, owing, no doubt, to the fact that these higher values are only observed during the passage of cyclonic disturbances laden with moisture from the Atlantic, when a great amount of this moisture only comes into the spectroscopic field in a condensed state, when it is forced to ascend so as to pass the summit, and consequently does not affect the rainband, but causes a very heavy rainfall. The moisture that ascends the mountain, not being detected below by the spectroscope here, is a constant source of disparities in the agreement of rainband and subsequent rainfall. The fact that our mean rainband is not greater than 1·7, and that the amounts of rainfall were, for 1885, 146·497 inches, and for 1886, 107·847 inches, clearly indicates that a great part of our rainfall is due to the condensation of the moisture that is forced up from below the level of the summit.

In comparing rainband with subsequent rainfall, the temperature of the air at the time of observation, as well as the variation in the temperature, must be taken into account. With the view of ascertaining the relations between rainband, subsequent rainfall, and temperature, the mean hourly rainfall for the three hours after an observation, for each number of the rainband scale, and for every 5° of temperature from 15° to 50°, has been calculated, and the results for rainbands of values 1, 2, and 3, are as follows :—

Temperature		15°	20°	25°	30°	35°	40°	45°	50°
Rainband	1 ...	·003	·005	·010	·006	·006	·004	·000	·000
	2 ...	·005	·010	·024	·015	012	·006	·003	·000
	3 ...	·007	·013	·026	·019	·016	·015	·009	·003

The means for temperatures of 25° and upwards show that for any one rainband, when the temperature rises the rainfall decreases, and when the temperature falls the rainfall increases. The results being as yet only tentative, it cannot be definitely stated by how much the mean hourly rainfall increases or decreases per degree of fall or rise in the temperature, for any one value of the rainband. The means for temperatures below 25° seem to indicate that a fall in the temperature causes a decrease in the rainfall, which is not at all probable. If it be the case that low temperatures do not affect the absorbing powers of aqueous vapour, which is not likely, the smal amount of rainfall at these low temperatures may be due to the necessarily unsatisfactory measurements of precipitation obtained from the rain-gauge when the temperature is below 32°. In truth, snowfall and rainfall as measured by the rain-gauge, can hardly be compared with each other. For a full account of these and other questions of rainfall here, see Mr. Omond's articles and also Mr. Buchan's "Meteorology of Ben Nevis" in the Journal of the Scottish Meteorological Society for the last two years.

The mean rainbands at the different temperatures are :—

Temperature	15°	20°	25°	30°	35°	40°	45°	50°
Rainband ...	0·4	1·1	1·1	1·5	1·9	2·4	2·5	2·3

The greatest number of observations at any one temperature was 724 at 30°, and the least 35 at 50°.

The reason why so many observations were made in 1886 was to find whether there was any daily variation in the rainband. That there is a slight variation will be seen from the following results, which are for the summer months only, viz. :—

Hour	6	7	8	9	10	11	12 noon
Rainband	1·4	1·4	1·6	1·5	1·6	1·6	1·7
Temperature	32°·0	32°·3	32°·7	33°·2	33°·5	34°·0	34°·4

Hour	13	14	15	16	17	18
Rainband	1·7	1·7	1·8	1·7	1·8	1·7
Temperature	34°·8	35°·0	35°·0	34°·9	34°·7	34°·3

The rise in the rainband from 6 a.m. till 3 p.m. following the temperature, points to the cause of this daily variation as being the expansion of the lower atmosphere by the rising temperature, and the consequent raising of the vapour above the level of the Ben. This is almost the same cause to which Mr. Buchan ascribes the rise in the barometric pressure for the same daily period. Prof. Piazzi Smyth says that the rainband does not increase for a rise of temperature *at sea-level*, because the total quantity of vapour over the place of observation is pretty constant (Journal Scot. Met. Soc., vol. v.). But over this summit the quantity of vapour is not constant, but varies, and the rainband varies with it.

Remarkable variations in the rainband occur in the course of a single day, often amounting to 3, and sometimes to 5 and 6. On March 26, 1886, when a cyclone was passing to the north of the Observatory, the rainband varied from 6 at 10 a.m., to 3 at 12 noon, and to 1 at 5 p.m. The strongest mean for any one day was 8 on January 1, 1886, while a mean of 0 has frequently occurred. On December 18, 1885, a rainband, estimated at 12, was observed on the rising sun—this was one of the noted "fore-glow" mornings. In anticyclonic weather, which is characterised by great dryness of the air, with all the clouds at lower levels, a strong rainband is always obtained from the layer of air close over the clouds, in summer, when not a trace is detected at the usual height of observation ; but in similar weather in winter the rainband is often entirely absent, even over the clouds. It is noteworthy that on days with little or no rainband, when not actually looking at the sun, the spectrum as a whole is darker than usual, and on days with strong rainbands, the parts of the spectrum not occupied by lines are brighter than usual. In a certain type of weather, when the rain-gauge completely fails to record the precipitation, the rainband always indicates the presence in the air of the vapour which gives it. This occurs when snow-crystals are deposited with low temperatures and strong winds, as described in NATURE (vol. xxxi. p. 532). The importance of rainband observations will be greatly increased when similar series can be undertaken at the sea-level simultaneously with those on the summit of Ben Nevis.

A. RANKIN

DO SCORPIONS COMMIT SUICIDE?

CORRESPONDENTS of NATURE have repeatedly raised the question whether there is any truth in the old legend that a scorpion, when placed within a ring of red-hot embers, will, after making futile efforts to pass the fiery circle, deliberately kill itself by inflicting a wound with a sting in its own head. Surgeon-General Bidie, of Madras (vol. xi. p. 29), Dr. Allen Thomson (vol. xx. p. 577), and Mr. Gillman (vol. xx. p. 629), have answered the question in the affirmative. The other side has been taken by Mr. Hutchinson (vol. xxi. p. 226), Mr. Curran (vol. xxi. p. 325), and Mr. Lloyd Morgan (vol. xxvii. p. 313). Mr. Hutchinson maintained that the animals experimented on by Mr. Gillman had died from excessive heat. To this Mr. Gillman replied, that the temperature in the centre of such a circle of glowing charcoal as he used does not exceed 50° C.

The subject has lately been thoroughly investigated by Mr. Alfred G. Bourne, Professor of Biology in the Presidency College, Madras; and the results of his observations have been set forth in a paper communicated to the Royal Society by Prof. Ray Lankester. Some of the details of his experiments are not very pleasant reading, but it must be remembered that the question is one of considerable importance, because, if it could be proved that the scorpion commits suicide, its impulse to do so would be, as Mr. Romanes has pointed out, "a unique case of an instinct detrimental alike to the individual and to the species."

One of the arguments used to disprove the existence of the supposed instinct is, that it is physically impossible for a scorpion to sting itself in a vulnerable place. Mr. Bourne shows that this statement is inaccurate. If, he says, a dead scorpion be taken which is quite limp and not in a state of rigour, it will be easily seen that the last four segments of the tail are about the only portions of the body, whether on the dorsal or ventral surface, where a scorpion could *not* sting itself. Further, if two fighting scorpions be watched, it will be seen that the extent to which the sting can be moved about is perfectly wonderful. Moreover, he has noticed that, when the scorpion is placed in very unpleasant circumstances, it not unfrequently lashes its tail about and causes actual penetration of the sting. If, for instance, the rays of a burning-glass be concentrated on any part of the body, the scorpion brings its sting there, and tries to strike away the source of irritation. Occasionally its efforts become more and more frantic, and the point of the sting catches somewhere. The scorpion, however, does not die unless the heat is concentrated on the back. In that case it soon succumbs, even if the sting has been tied down or previously removed.

The most important of Mr. Bourne's propositions is that the poison of a scorpion is quite powerless to kill the same individual, or another individual of the same species, or even scorpions of other species. If this proposition is established, there can, of course, be no further controversy about the matter. *A priori*, it is not improbable, for Sir Joseph Fayrer has shown that the cobra poison will not affect a cobra. Mr. Bourne frequently took a scorpion in his hand, and, holding the sting between a pair of forceps, pricked the scorpion with the sting and squeezed out its poison. There was a little bleeding from the wound, but in every case the scorpion lived for days. He also tried stinging one scorpion with another, using in the first instance specimens of the same species, then specimens of different species. Occasionally, he thinks, the stung individual became a trifle sluggish, but it never died from the sting. In order to make sure that his method of squeezing out the poison was perfectly effective, Mr. Bourne, after stinging a scorpion, sometimes continued to hold the sting, and, taking a cockroach, squeezed out into it some more of the poison. The cockroach invariably became very sluggish at once, and died in an hour or so. He also used a large cricket, stinging it in the femur of the large hind-leg; that leg became paralysed. When the animal was stung in the same place on both sides, both the hind-legs became useless, and it crawled away on the two anterior pairs of legs. Stung in the thorax it became quite torpid; when placed on its back it was not able to turn over. After considerable search, Mr. Bourne procured some specimens of *Thelyphonus*, which he chose as being the nearest relatives of the scorpions. He stung these in his usual method, and in each case they died within six seconds. He then tried some spiders, and they died in a few minutes when well stung. The slower general action in cockroaches and crickets is probably, he supposes, to be explained by the very inefficient circulation of the blood in insects as compared with Arachnida.

In all cases of artificial stinging Mr. Bourne took especial care to avoid mechanical injury to the nerve ganglia. And he tried puncture without the introduction of scorpion poison. Using large insects for this purpose, he obtained complete freedom from ill effects when using simple puncture, whereas the same species of insects when punctured with introduction of scorpion poison were instantly paralysed, and died in half an hour. He also procured two small shore crabs. One he punctured between two joints of the great chela of one side; several drops of blood exuded, but they coagulated, and the crab remained well. The second he stung in the same place with scorpion's sting, squeezing it to insure poisoning. The claw was immediately paralysed, and the crab gradually became torpid, and died in less than an hour.

When a number of scorpions are kept together in captivity, it is not difficult to induce a couple to fight. Mr. Bourne isolated such a couple, and they fought on and off for two days, during which time each repeatedly stung the other. On another occasion he separated two scorpions which had been fighting, and which had repeatedly stung one another. They lived perfectly well.

Apropos of Mr. Gillman's remarks about the actual temperature to which the scorpion is subjected in the "fiery circle," Mr. Bourne tried this experiment. He placed a scorpion and a cockroach (for comparison) in an incubator with glass sides, and gave them a piece of wood to walk about upon, and gradually raised the temperature. At 40° C. both seemed uncomfortable, and the cockroach performed a sort of licking action on all its legs and antennæ. At 45° C. the scorpion became very sluggish, and at 50° C. it was nearly dead. A large furious scorpion before the experiment, it now lay on its back and did not attempt to get up. Mr. Bourne took it out and gave it a cold bath, and put it in a cool earthenware vessel, and in the course of two hours it recovered. The cockroach was left in the incubator till the temperature reached 52° C. When nearly dead, it was taken out, and very gradually recovered. To try the effect of a wet heat, a scorpion and a cockroach were placed in water at 43° C., and they both died almost immediately, whereas they would both have lived in cold water for hours.

The inference drawn by Mr. Bourne from his experiments is that scorpions do not commit suicide, and that when they die within a ring of fire, heat is the cause of death. After he had reached this conclusion he was told that according to some authorities inclosure in a circle of oil, or inclosure under an inverted tumbler, will cause a scorpion to kill itself. He accordingly placed a scorpion on a plate within a ring of cocoa-nut oil. It calmly walked through. He placed another scorpion on a plate, and round the edge a thick roll of rag dripping with kerosene oil. The animal walked out over the rag. When daubed with oil, it appeared uncomfortable, but did nothing remarkable. The experiment with an inverted tumbler was made, and gave the same negative result.

THE MYTHICAL ZOOLOGY OF THE FAR EAST

A SHORT time ago the British Museum acquired a comprehensive collection of Japanese and Chinese pictures, made by Mr. William Anderson, for some years medical officer to the British Legation in Tokio. This gentleman's magnificent work on the "Pictorial Arts of Japan" has already been noticed in these columns; and he has just placed students of the arts of the Far East under an additional debt of gratitude to him by the preparation of a catalogue of his collection in the British Museum, which has just been published by the Trustees of that institution. With this volume, except for a special purpose, we have nothing to do; but it is impossible to glance through it without being struck by the amount of labour which the author has devoted to his dissertations on the various schools of painting, to his descriptions of characteristic examples of these schools, and to his explanation of the motives which inspired the artists. The word "catalogue" is a modest one to employ in describing the work, for though it contains the numbers and names of the pictures, this is the least part of its contents.

Amongst the motives of the artists of China and Japan, mythical zoology held a very important place; it evidences, says Mr. Anderson, "a courage of invention almost unparalleled in the pseudo-science of Oriental races." It holds, too, a disproportionate place in the folk-lore and superstitions of the people of both countries. Yet it has scarcely received any attention in Europe. In Prof. Angelo de Gubernatis's great work on "Zoological Mythology" there is but a single reference to China, and none at all to Japan, while the myths of Aryan nations occupy the greater part of his volumes. Here and there in books relating to the countries of Eastern Asia scanty references to popular myths respecting animals are found, but, so far as we are aware, Mr. Anderson's is the first work which gives any adequate conception of the marvellous extent of this species of lore amongst the Chinese and Japanese. As the latter owe their art, literature, and religion to China, so they owe also their scientific myths. The Chinese have developed mythical zoology to a greater extent than any other nation. "Their literature teems with strange conceits, some of which appear to be transcripts of local folk-lore, others appertain to Buddhism or Taoistic legends, and others are accepted as sober facts of natural history." These have almost all been adopted and improved in treatment by the Japanese.

Mr. Anderson divides the anthropological myths into three classes:—

(1) Persons born of woman with or without divine agency, who develop magical powers, work miracles, and attain a fabulous longevity.

(2) Those distinguished by physical peculiarities of a fabulous nature. Amongst these are giants; dwarfs; perforated men, who are conveyed about by coolies by means of poles put through holes which conveniently exist in their bodies for this purpose; stomachless men, who, according to popular belief, "dare not laugh for they have no sides to hold"; men with enormously long legs, and those with similarly long arms; men with tails, who carefully dig holes where they sit in order to provide a receptacle for the appendage; and many other extraordinary beings, all of which are truthfully described, from Chinese works of authority and repute, in the great Japanese encyclopædia *Wa-Kan-San-Sai dzu-yé*.

(3) Transitional beings, who combine with human elements parts naturally appertaining to the lower animals: such are feathered men; those with human faces, but the wings and beak of a bird; mermen, who have human heads and arms attached to the body of a fish, and learn the secrets of the deep from the murmuring hollow of the Conchifer. To this section also belongs the vampire bride who lures men to her deadly embraces till she has drained away their life-blood.

Mythical animals are similarly classified:—

(1) Those without any remarkable peculiarities of conformation, but gifted with supernatural attributes. Thus the tiger is classed in Chinese mythology as one of the supernatural animals, the king of beasts, and the representative of the masculine or active principle of Nature. It attains the age of a thousand years, and after passing the half of this term its hair becomes white. It is sometimes seen in association with the dragon, apparently as the emblem of the power of faith; it is also regarded as the type of wisdom, and in illustration of this attribute Mr. Anderson gives a story (p. 51) which has a familiar analogy in European folk-lore. The fox, again, is the demon of mischief, with the power of changing his shape at will, but ever with some evil design on the comfort of mankind. When he reaches the age of fifty, Mr. Anderson tells us, he is able to accomplish at will his most favourite and baneful metamorphosis into the resemblance of womankind; at a hundred he can take the shape either of a young and beautiful girl, or of a wizard strong in all the powers of magic; and when he reaches the term of a thousand years he becomes a Celestial Fox, characterised by a golden colour and nine tails, and may be admitted to heaven. But it appears he does not always avail himself of this privilege, for the possession of the extra tails only gives him an augmented cunning and capacity for wickedness. The tortoise also attains a marvellous longevity, and is variously represented as the embodiment of a star in Ursa Major, and as a descendant of the first dragon. In Hindoo mythology the tortoise supports the elephant which supports the world; in Japanese art it is represented as bearing on its back the mountain abode of the immortals. The horse is also associated with longevity, and it is still a popular belief that the female is delivered of its progeny through the mouth. The crane is one of the commonest figures in Japanese art; in Chinese mythical zoology there are four varieties, distinguished by their colours; they all live to a fabulous age, and after completing six hundred years are superior to the necessity of other sustenance than water. Many other notices of animals belonging to this class are scattered throughout Mr. Anderson's book in connection with pictures in which they are represented.

(2) Animals differing from their fellows only in size, or in alterations of the due number of parts. Such are serpents eight hundred feet long, which devour elephants; nine-tailed foxes; the four-eared monkey which heralds the deluge; the fish with ten bodies and one head, whose flesh is a sure preventive of boils; and many others.

(3) Creatures made up by the amalgamation of parts of various animals. Amongst these composite monsters the principal is the dragon, which, according to the Japanese encyclopædia already mentioned, has the head of a camel, the horns of a deer, the eyes of a demon, the ears of an ox, the body of a serpent, the scales of a carp, and the claws of an eagle. It is not necessary to say more by way of description, for it is the most familiar object in the art of China and Japan. It is treated by writers of the last century as really existing. It becomes at will, according to a Chinese author of the seventh century B.C., reduced to the size of a silkworm, or swollen till it fills the space of heaven and earth. "In Chinese Buddhism it plays an important part, either as a force auxiliary to the law, or as a malevolent creature to be converted or quelled." It is a guardian of the faith, an attribute of saintly or divine personages, an enemy of mankind, an emblem of majesty, the presiding genius of rainfall, and a symbol of time and place, giving its name to certain days and years, and to a point of the compass. Many more details about this extraordinary creature will be found scattered through Mr. Anderson's book, especially on pp. 48 *et seq.* The *kilin* or *kirin*, "the noblest form of the animal creation,

and an emblem of perfect good," also belongs to this class. It has the body of a deer, the tail of an ox, and a single horn, so that it resembles the unicorn. The phœnix is another animal of this kind, with the head of a pheasant, the beak of a swallow, the neck of a tortoise, and the outward resemblance of a dragon. It is regarded as an omen of good, and heralds the advent of a beneficent reign. "In works of art it is a nondescript bird of gorgeous plumage, intermediate between that of the peacock and bird of paradise, and bears flame-like appendages where the neck joins the body."

All the creatures referred to here, and many more belonging to one or other of the classes of zoological myths, are represented pictorially in the *Wa-Kan-San-Sai dzu-yé*, already mentioned, and in the *Mangwa* of Hokusai, a book to which access can be obtained without difficulty in most of the capitals of Europe.

To the mythical animals already mentioned, which are common to China and Japan, the Japanese have added some of their own invention. Such are serpents, giant centipedes, monster devil-fishes; earth-spiders, probably representing the troglodytes of old Japan; the raccoon-faced dog, which possesses in a minor degree the evil powers and tendencies of the fox; the wolf-like animal which produces thunder; the "whirling neck," or being which has the power of so elongating the neck that the head appears in places remote from the body; the man-devouring *kappa*, which frequents rivers and ponds, and politely challenges wayfarers to single combat; and many other equally strange creatures. An outline sketch of Japanese demonology will be found at p. 59, and a striking myth of a demon spider at p. 109.

Enough, however, has been said to show that if Mr. Anderson, in his catalogue and larger work on the "Pictoral Arts of Japan," has revealed to British readers a new and most important branch of art, he has incidentally indicated to his readers a new world of myth, which has hitherto found no place in the consideration of students of comparative mythology in Europe, but which can now be no longer neglected. Mr. Anderson of course treats it almost solely in its relation to art, but he informs the reader in every case where further and more detailed information may be obtained. The task of tracing these myths to their source and of finding analogies elsewhere is one for the scientific inquirer. Mr. Anderson has done the more laborious part of the work in bringing them together. He also suggests that very many of them will be found to have their homes in India, and to have spread with the doctrines of Buddha to China and other far eastern countries. One great advantage which the student of the zoological and other myths of China and Japan will have is that in the exhibition of the Anderson Collection, which is shortly to be opened at the British Museum, he will be able to see in the most graphic form the conceptions of successive generations of artists of the beings to which the myths relate—an advantage which could not be obtained even in the countries themselves without considerable expenditure of money, time, and labour. It only remains to be said that we have adopted Mr. Anderson's classifications, and in many instances have employed his own words in the descriptions of the myths scattered in so much profusion throughout the catalogue.

NOTES

WE regret to have to announce the death, on Good Friday, at the Nice Observatory, of M. Thollon, the eminent spectroscopist. Few men devoted to spectroscopic inquiry have worked so unceasingly and successfully; and in him Science loses one of the most single-minded of her votaries. He has been cut off in the midst of his labours, which, especially since his location at M. Bischoffsheim's magnificent observatory and the completion of the spectroscopic installation there, have borne such rich fruit in the shape of a method of sorting out the telluric from the true solar lines (a method slightly modified by Cornu), and of a map of the solar spectrum as observed by the new form of spectroscope of his own invention, which vastly surpasses in dispersion and purity of image anything that preceded it. Dr. Thollon has not only worked at Nice, but at the Pic du Midi and the Paris Observatory; he was also one of the observers of the total solar eclipse in Egypt in 1882. In all his wanderings, as in his work, he made many friends, and all who knew him will mourn his loss, not only as a man of science, but as one possessing, above the ordinary degree, a true and genial nature.

ON March 5 a drawing-room meeting for the promotion of technical education was held at the house of Mr. E. C. Robins, under the presidency of Prof. Huxley. A Memorandum of the proceedings has now been printed for private circulation. An address on the technical training at the Central Institution at South Kensington was delivered by Prof. Ayrton. The address was followed by a discussion, in which Prof. Silvanus Thompson, Mr. Brewin, Prof. Perry, Prof. Henrici, and others took part. In summing up the debate, Prof. Huxley remarked that something had been said about rivalry between the Central Institution and the Finsbury School. That most excellent and vigorous school which the City and Guilds Institute had established at Finsbury was chiefly intended to give primary technical instruction to workmen and others who could snatch only a few hours a week from their daily labour for the purpose of receiving it. The Central Institution, on the other hand, was chiefly intended for the advanced instruction of persons who could give up their time for one or more years to the higher branches of technology. Exhibitions enabled the promising student of the schools at Finsbury and elsewhere to pass to the Central Institution, and profit by the advantages it offered him. To talk of rivalry between the two was like talking of a rivalry between Eton and Cambridge. No doubt the day would come when a score of such schools as that at Finsbury would be sending their picked scholars to the Central Institution; but, before that day could come, the organisation of the Central Institute must be so far completed that it could receive them and deal with them. A great deal had been said about the 100,000*l*. or 150,000*l*., or whatever it was, that had already been spent on the Central Institution, and of the 10,000*l*. a year that it cost. He begged leave to repeat that which he had said elsewhere, that if in the course of the next ten years the City and Guilds Institute could succeed in catching and training another Faraday or Whitworth or Armstrong, he would from a mere commercial point of view be worth all the expenditure initial and assured.

A HIGHLY interesting series of experiments has recently been successfully carried out by M. Olszewski. The more permanent gases have not only been liquefied at pressures averaging only 740 mm. by aid of excessively low temperatures, but the boiling-points, melting-points, and densities of these so-called gases have been determined at atmospheric pressure. The glass tube in which the condensation was effected was surrounded by a bath of liquefied ethylene, which could be caused to boil by reduction of its pressure, and, by use of a specially constructed air-pump, was reduced in temperature to -150°. When this point was reached, the gas to be liquefied was admitted into the tube from a Natterer cylinder containing the gas at about 40-60 atmospheres pressure, and was readily liquefied. A hydrogen thermometer was used to determine the temperature of the liquid, and the boiling-point of methane at

atmospheric pressure was found to be -164° C., that of oxygen $-181^\circ\cdot4$, nitrogen $-194^\circ\cdot4$, carbon monoxide -190°, and nitric oxide $-153^\circ\cdot6$. The melting-point of carbon monoxide was also determined to be -207°, and that of nitrogen as low as -214°. M. Oslzewski's nearest approach to absolute zero was -225° for solid nitrogen. The density of methane at 736 mm. and -164° was found to be 0·415, that of oxygen at 743 mm. and $-181^\circ\cdot4$ was 1·124, while that of nitrogen at 741 mm. and $-194^\circ\cdot4$ was found to be 0·885. The densities were determined by reading off the position of the liquid meniscus in the tube, volatilising a portion by means of an aspirator, and again reading off the height of the column, the volume of the volatilised portion being measured by the amount of water running out of the aspirator. At the fifth experiment with nitrogen, the tube, which had survived two years' experiments, burst, and destroyed the apparatus, so that the densities of carbon monoxide and nitric oxide must be left for future experiments.

ON Saturday next, and the two following Saturdays, Dr. R. von Lendenfeld will deliver a course of lectures at the Royal Institution on recent scientific researches in Australasia.

ON the 4th inst. the first meeting of the Sanitary Legislation Conference was held in the rooms of the Sanitary Assurance Association. The following resolutions were passed: (1) that the sanitary registration of all buildings is desirable in the interest of the public health; (2) that it is desirable that the law should forbid any building being used for public or semi-public purposes, unless and until the arrangements for the water-supply, drainage, and ventilation of such building have been certified as satisfactory by some properly-qualified person; and (3) that the provision of a public sanitary register for the voluntary registration of private houses would be instrumental in promoting sanitary improvement.

AN important topographical and geological expedition has been organised by the Canadian Government for the exploration of the country watered by the River Yukan. According to Lieut. Schwalk, who went over much of the ground for the U.S. Government in 1883, this river is over 2000 miles in length, and it is believed that in many districts there are valuable deposits of gold. The Expedition will start from Victoria, British Columbia, early in May. The part of the work relating to geology and natural history will be conducted by Dr. Dawson, Assistant-Director of the Canadian Geological Survey; and under him Mr. W. Ogilvy will take charge of the topographical work, and make an accurate survey and measurement of as much of the Yukan as lies within British territory.

IT has been determined to transfer the Observatory of Rio de Janeiro to Santa Cruz, nearly on the same parallel, and a little more to the west. The Observatory is of considerable importance, owing to its position, being nearly on the Tropic of Capricorn, and it has recently been greatly improved by the present Director, Sr. Cruls. It is stated in the *Bollettino mensuale* of the Italian Meteorological Society, that from January of the present year the Observatory will commence the publication of a monthly Bulletin containing *inter alia* the meteorological observations made at fifteen stations in Brazil. Hitherto observations from that country have been very scarce indeed.

AFTER the first International Ornithographical Congress at Vienna in 1884, numerous stations for observing the habits of birds were organised all over the world. Dr. A. B. Meyer, the Director of the Zoological Museum at Dresden, was appointed Director for the erection of all such stations in Saxony. This gentleman, together with Dr. F. Helm, of Arnoldsgrün, has just published the first Annual Summary for the year 1885. It contains the results of about forty-eight series of observations from thirty-six stations, and articles on 180 species of birds.

WE have received four numbers of the "Encyclopædie der Wissenschaften," edited by various eminent German men of science, and issued by Trewendt of Breslau. One of these numbers concludes an elaborate dictionary of mineralogy, geology, and palæontology. Two others form part of an equally elaborate dictionary of chemistry, and the remaining number contains some sections of a treatise on botany.

THE Religious Tract Society are about to publish "Pioneering in New Guinea," by the Rev. James Chalmers, who has lived and travelled in New Guinea during the last eight years. A special chapter contains answers given by natives to 115 questions carefully drawn up by Mr. Chalmers.

"A LIST OF BRITISH BIRDS," revised by Mr. Howard Saunders, will be found of much service both for the labelling of specimens and for reference. It has just been issued by Messrs. Gurney and Jackson.

EARTHQUAKES on April 1, 2, 3, and 4 are reported from Aden. No damage was done.

WE hear that Mr. Murray has resigned the post of Librarian and Curator to the Karachi Museum. During his tenure of office he has written several hand-books on the zoology of Sind, and his Catalogue of the vertebrate fauna of that province is a valuable epitome of the subject. He will be succeeded by Mr. W. D. Cumming, who was for some time stationed at Fao, in the Persian Gulf. While there Mr. Cumming devoted himself with much energy to the study of the avifauna of the neighbourhood, and sent several interesting collections to England, where they have been described by Mr. Bowdler Sharpe. The collections proved to be one of the most important acquisitions of the British Museum during the year 1886.

LARGE cases, showing the nests of the Heron, Hen-harrier, Starling, Sand-Martin, and Common Tern, have been lately added to the Natural History Museum. Prof. Flower has also placed in the great hall a large case illustrating the principal breeds of domestic pigeons derived by man's selection from the common blue Rock-pigeon (*Columba livia*). Popular guides to most of the departments have recently been published by the Trustees, and the Index Museum in the great hall bids fair to supply the student with a complete introduction to the study of zoology and botany. In face of the energetic labours of the staff of this Museum to render the collections under their charge educational for the masses, it is satisfactory to learn that several members of Parliament have announced their intention of questioning the wisdom of reducing the grant to the British Museum, as has been done this year in deference to the rage for economy at present in vogue.

PROF. BARBOZA DU BOCAGE has recently described a Sunbird and a Grass-warbler from the Island of St. Thomas as *Cinnyris newtonii* and *Prinia molleri*. Zoologists will welcome the return of Prof. Bocage from the realms of politics back to the charge of the Lisbon Museum, which, under his care, rose to a position of first-rate importance.

VOLUME I. of the Journal of the Science College of the Imperial University, Japan, which has been recently published, contains a valuable paper by Mr. Sekei Sekiya, Professor of Seismology in the University, on the comparison of earthquake records given at the same station by different seismographs, the

comparison being made as a test of the accuracy of the instruments. Two recent earthquakes are discussed, each of which was recorded in duplicate at the Tokio Observatory, by two somewhat different forms of Ewing's horizontal pendulum seimograph, and the autographic records are reproduced in the paper. Prof. Sekiya compares the corresponding motions as recorded by different instruments, and remarks that when the records are gone through, wave by wave, the corresponding pointers are found to have drawn waves of exactly the same amplitude and period, and even the irregular minor ripples which are superposed on the principal undulations are reproduced faithfully by both. He concludes that this exact coincidence proves conclusively the trustworthiness of the horizontal pendulum seismograph. The diagrams reproduced in the Journal also show the vertical motion of the ground, as recorded by Ewing's vertical motion seismograph. This motion, the author points out, is much less in amplitude than the horizontal motion (usually from $\frac{1}{5}$ to $\frac{1}{3}$), and its average period is only about half that of the horizontal motion. The three components of motion, when combined, give a resultant form of extraordinary complexity for the path pursued by particles on the surface of the ground during an earthquake shock.

THE Association Scientifique de France has discontinued the publication of its weekly Bulletin, and will issue, instead, a *Compte rendu* of the Conferences of the Association in half-yearly volumes. A few advance parts will be published fortnightly, for the use of such of the members as may desire to have them. The Bulletin has been published since 1864.

MR. JAMES WILD, Geographer to the Queen, died at his London residence, at the age of seventy four, on the 17th inst. He was educated at Woolwich for the army, but afterwards devoted himself to the production of scientific and educational works. He soon became a member of various scientific Societies, and his maps and geographical works secured for him the position of Geographer to the Queen. For a good many years he had a seat in Parliament. After his retirement from political life he represented the Ward of Cornhill in the Common Council, and he took a leading part in directing the attention of the Clothworkers' Company, of which he was a member, to the subject of technical education. It was mainly through his efforts that the technical schools of Bristol, Manchester, and Leeds were erected. Among the many honours conferred upon him was the gold medal for scientific merit, granted by the present German Emperor as King of Prussia.

IN a paper entitled "Field Notes from Afghanistan," printed in the new number of Records of the Geological Survey of India, Mr. C. L. Griesbach gives an account of instances of recent glacial action observed by him when crossing the Hindu Kúsh by the Chahárdar Pass in October 1886. The road which leads from Chápdarra camping-ground on the north side of the Hindu Kúsh to the top of the pass ascends a narrow straight valley, bounded on each side by steep cliffs, some of them crowned with perpetual snow. The bottom of the valley itself is greatly choked and partially filled with debris, which might be simply the detritus from the hill-sides. Large cones and fans of fragmentary material descend from each small ravine on both sides. So far only the configuration of the valley, its nearly straight course and absence of larger side streams, would suggest the former presence of glaciers. But on reaching an elevation of 12,000 feet, one suddenly comes to a huge mass of debris, which closely resembles the recent accumulations near the lower end of a glacier. Large blocks, some of them of immense dimensions, are loosely mingled with angular fragments of every size, and the whole is arranged like a dam across the valley. The hill-sides (gneiss) are polished and grooved, and the blackened surfaces glisten and shine in the distance like metal. All the larger blocks show extensive grooving and deep ice-scratches on their polished sides. This mass of debris lies at the base of a terrace filling the valley. The former glacier, of which this is the end moraine, was on the upper and raised portion of the valley. The latter bears the remarkable appearance of an ice-worn trough; it is wider than the valley below, and its base is now partially filled by finer debris, through which a small stream winds its way amidst a series of swampy pools. It is within the area of perpetual snow, and the latter with frozen patches of ice lies on the hill-sides and in sheltered depressions. The valley looks as if the glacier had only quite recently left it. Moraines and glacial silt still lie as they were deposited. The head and catchment area of the valley close to the top of the pass (14,100 feet) is still rather thickly covered with frozen snow. Near the head of a narrow valley leading from the Chahárdar Pass to the Deh-i-Tang, at an elevation of 12,050 feet above sea-level, several small ravines join. Mr. Griesbach noticed that three of these ravines were still filled with glaciers. Although they were very small, the moraine accumulations near their lower ends were enormous.

IN a highly important and interesting paper on the structure of the Nostochineæ, contained in the first volume of the new Italian botanical journal *Malpighia*, Prof. A. Borzi, of Messina, states the very interesting fact that, in *Nostoc ellipsosporum* and other species of the same genus, a distinct communication can be detected between adjacent cells. If the cell is an intercalary one, it has two pores at opposite poles; if apical, only one; and through these pores pass very delicate threads of a substance which sometimes gives the reactions of protoplasm, sometimes of cyanophycin, the substance of which, according to Borzi, both the cell-contents and the investing gelatinous sheath of the Nostocaceæ are composed. This intercommunication between the cells is always interrupted in the formation of heterocysts. During the transformation of ordinary cells into heterocysts, the walls become thicker, the gelatinous substance of which they are composed collecting especially round the pores through which the strands pass, and eventually completely closing them up. In this way is formed a short conical projection pointing towards the interior of the heterocyst. In the vegetative cells of the filament, that is, those which are not destined to become heterocysts, the connecting threads appear always to consist of protoplasm. In the hormogones this connexion between adjacent cells is especially evident. In addition to several species of *Nostoc*, Prof. Borzi has observed this interesting phenomenon in several of the other families of Nostochineæ or filamentous Cyanophyceæ, viz. in the Scytonemaceæ, Stigonemaceæ, and Rivulariaceæ.

PROF. D. KIKUCHI, of Tokio, who graduated at Cambridge in 1877, is editing, at the request of the Education Department of the Japanese Government, text-books of geometry and algebra, those in use at present being very unsatisfactory. He has already translated and published the syllabus of plane geometry drawn up by the Association for the Improvement of Geometrical Teaching, and has also done the same for Clifford's "Common Sense of the Exact Sciences." His principal course of lectures—a two years' one—is on dynamics, commencing with statics, and including sound and liquid waves.

WITH reference to Mr. Hooper's paper on *Gymnema sylvestre*, printed by us last week, Mr. J. C. Shenstone writes to us that the peculiar properties of the plant were described in a communication to the Linnean Society, December 7, 1847, by Capt. Edgeworth. The plant was pointed out to him by the natives, who were aware of its peculiarity. "No doubt," says Mr. Shenstone, "this is the Mr. Edgeworth alluded to by Mr. Hooper in his paper as having first discovered the property of the plant, but a reference to the original communication may interest some of your readers."

An experimental passenger-train, lighted throughout by electricity, and heated by steam from the engine, is now running between New York and Boston. Each car is illuminated by eighteen 16-candle glow-lamps, the current being derived from storage-batteries beneath the floor-timbers, charged for ten hours by dynamos. Both light and heat are said to be ample, and *Science* believes that danger from fire, in case of accident to the train, is much lessened, if not almost wholly done away with.

Machinery for winding silk from cocoons was lately set up at Washington by the Department of Agriculture. Much interest is manifested in the experiments, and the demand for copies of the Bulletin on Silkworm Culture is so great that it has been necessary to issue seven or eight editions. According to officials of the Department of Agriculture, the requests for silkworm eggs have never been so numerous since the Department began their distribution. It is expected, therefore, that large quantities of American-grown silk will be placed upon the market this year.

When crossing the Atlantic, Prof. Dennis, of New York, recently made some observations to test the purity of the ocean-air. He had previously prepared capsules of sterilised gelatine. One which was exposed in a state-room on the main deck of the steamer developed five hundred points of infection in eighteen hours; one exposed in the cabin on the main deck developed only five or six points in ten days; a third, hung over the bow of the ship for ten days, remained uncontaminated.

Mr. V. G. Eaton, writing to the *Popular Science Monthly*, says that in most of the eastern cities of the Unites States fully 30 per cent. of the men over thirty years of age show unmistakable signs of baldness, while nearly 20 per cent. have spots on their heads that are not only bald, but polished with the gloss that is supposed to belong to extreme old age alone. He has been in most of the churches and theatres in all the large eastern cities, as well as in Chicago, St. Louis, and other places of the West, and has verified his assertion by actual count. He has found that bald-headed men are most plentiful in New York and Boston, and that after these cities come Philadelphia, Washington, and the western towns. The following are a few of his observations taken in Boston:—Trinity Church: 243 men; 71 actually bald, 46 indications of baldness. King's Chapel: 86 men; 38 actually bald, 14 indications of baldness. Hollis Street Theatre, orchestra at performance of the "Mikado": 63 men; 27 actually bald, 10 indications. Boston Theatre, Judic: 126 men; 51 actually bald, 43 indications.

The additions to the Zoological Society's Gardens during the past week include two Polar Bears (*Ursus maritimus*), from the Polar Regions, presented by Mr. Joseph Monteith; two Brown-throated Conures (*Conurus æruginosus*), from South America, presented by Lieut.-General Newton; a Ring Dove (*Columba palumbarius*), a Turtle Dove (*Turtur communis*), British, presented by Mr. C. L. Sutherland, F.Z.S.; a Secretary Vulture (*Serpentarius reptilivorus*), from South Africa, presented by Mr. J. Newbury; a White-tailed Buzzard (*Buteo albicaudatus*), from America, presented by Mr. John Lloyd; two Common Gulls (*Larus canus*), British, presented by Mr. J. A. Cotton; two —— Ducks (——) from the Falkland Isles, presented by Mr. F. E. Cobb, C.M.Z.S.; two Viscachas (*Lagostomus trichodactylus*), born in the Gardens.

OUR ASTRONOMICAL COLUMN

The U.S. Naval Observatory.—We learn from *Science*, vol. ix. No. 217, that the new Naval Observatory, for which Congress appropriated 400,000 dollars several years ago, is to be built forthwith. Mr. R. M. Hunt, of New York, has been appointed architect of the building, and operations will shortly begin.

Researches on the Sun's Diameter.—Prof. Di Legge, of the Campidoglio Observatory, Rome, has published in *Atti della R. Accademia dei Lincei*, ser. 4, vol. i., a discussion of the meridian transit observations of the sun's diameter taken at the Observatory during the years 1874–83. From May 1876 the observations were made by projecting the sun's image on a screen, so that two or more persons could observe simultaneously, and thus determine their "personal equations" from observations made under precisely similar circumstances. Altogether, 5796 transits were observed on 2213 days, giving an average of 221 days per annum. The mean resulting horizontal semi-diameters of the sun, collected in biennial groups, show a progressive diminution, which, taking into consideration Auwers' researches on the subject (Nature, vol. xxxv. p. 496), are most probably due to change in the habits of the observers, as the table of mean annual personal equations given by Prof. Di Legge would also lead us to infer. The mean values of the horizontal semi-diameter at mean distance found from each observer's transits are respectively as follows:—Di Legge, 961″·329 ± 0″·011; Respighi, 960″·760 ± 0″·013; Giacomelli, 961″·307 ± 0″·012; and Prosperi, 961″·356 ± 0″·014; the combined mean value being 961″·188.

ASTRONOMICAL PHENOMENA FOR THE WEEK 1887 APRIL 24–30

(For the reckoning of time the civil day, commencing at Greenwich mean midnight, counting the hours on to 24, is here employed.)

At Greenwich on April 24

Sun rises, 4h. 48m.; souths, 11h. 58m. 5·6s.; sets, 19h. 8m.; decl. on meridian, 12° 51′ N.: Sidereal Time at Sunset, 9h. 18m.

Moon (at First Quarter on April 30) rises, 5h. 48m.; souths, 12h. 55m.; sets, 20h. 14m.; decl. on meridian, 12° 11′ N.

Planet	Rises h. m.	Souths h. m.	Sets h. m.	Decl. on meridian ° ′
Mercury ...	... 4 17	... 10 23	... 16 29	... 0 20 N.
Venus ...	... 6 1	... 14 13	... 22 25	... 22 50 N.
Mars ...	... 4 50	... 11 59	... 19 8	... 12 37 N.
Jupiter...	... 18 34	... 23 45	... 4 56*	... 10 17 S.
Saturn...	... 8 54	... 17 3	... 1 12*	... 22 24 N.

* Indicates that the setting is that of the following morning.

Occultations of Stars by the Moon (visible at Greenwich)

April	Star	Mag.	Disap. h. m.	Reap. h. m.	Corresponding angles from vertex to right for inverted image ° °
25 ...	48 Tauri ...	... 6	... 21 0	... 21 36	... 85 359
30 ...	3 Cancri ...	... 6	... 0 13	... 1 4	... 119 293
30 ...	54 Cancri...	... 6½	... 21 36	... 22 27	... 74 330

April	h.	
24 ...	23 ...	Mars in conjunction with the Sun.
26 ...	6 ...	Venus in conjunction with and 6° 19′ north of the Moon.
29 ...	7 ...	Saturn in conjunction with and 3° 6′ north of the Moon.

Variable Stars

Star	R.A. h. m.	Decl. ° ′		h. m.	
U Cephei	0 52·3	... 81 16 N.	... Apr. 29,	4 0	*m*
S Canis Minoris ...	7 26·6	... 8 34 N.	... ,, 29,		*m*
S Cancri	8 37·5	.. 19 26 N.	... ,, 28,	21 13	*m*
T Ursæ Majoris ...	12 31·3	... 60 7 N.	... ,, 27,		*m*
δ Libræ	14 54·9	... 8 4 S.	... ,, 27,	20 37	*m*
U Coronæ	15 13·6	... 32 4 N.	... ,, 24,	2 42	*m*
R Draconis	16 32·4	... 67 0 N.	... ,, 28,		*M*
U Ophiuchi... ...	17 10·8	... 1 20 N.	... ,, 24,	21 11	*m*
			and at intervals of	20 8	
S Delphini	20 37·9	... 16 41 N.	... Apr. 24,		*M*
δ Cephei	22 25·0	... 57 50 N.	... ,, 30,	22 0	*M*
R Lacertæ	22 38·3	... 41 47 N.	... ,, 27,		*m*

M signifies maximum; *m* minimum.

Meteor-Showers

	R.A. °	Decl. °	
Near ζ Ursæ Majoris...	206 ...	57 N.	Bright, slow meteors.
,, β Libræ	228 ...	5 S.	
,, α Serpentis ...	235 ...	9 N.	Swift meteors.

GEOGRAPHICAL NOTES

THE new volume (xi.) of the *Geographisches Jahrbuch*, edited by Prof. Hermann Wagner, begins a new series, and assumes a new form. It has been elongated from the small square form with which we have been familiar, into a respectable octavo, containing about 500 pages. Moreover the present volume is entirely devoted to what in former years was only a section: an account of progress in the various departments into which scientific geography is divided. The next volume will no doubt contain memoirs on various subjects of geographical interest. The subject of physical geography (or rather geophysics) is treated by Dr. Hergesell and Dr. Rudolph. Prof. Toula deals with the investigations of the last four years in the geognostic structure of the earth's surface in all parts of the world. The progress of oceanography is of course dealt with by the great authority on the subject, Dr. O. Krümmel, while Dr. Hann does a similar service for geographical meteorology, or climate. Botanical geography is treated by Dr. Oscar Drude, and zoological geography by Dr. L. K. Schmarda. Dr. G. Gerland gives the results of research in ethnology during 1884-86 in the various quarters of the globe. Under Dr. Wagner's sole editorship the *Jahrbuch* is becoming more valuable than ever as a book of reference in scientific geography.

THE Rev. George Grenfell, the explorer of the Mobangi and other important tributaries of the Congo, has arrived in London. Unfortunately his health is by no means satisfactory, and it will be necessary for him to rest for some time, therefore his appearance at the Royal Geographical Society must be delayed. He has brought home with him his original maps, which are admirable specimens of such work. They are on a scale of about 5 inches to a mile, and are evidently plotted with the greatest care; his work is therefore likely to take a high place. Dr. Lenz, who has arrived in Vienna, it is hoped will be in London at the end of this month, and as Dr. Junker may be here about the same time, it is just possible that both these eminent explorers may appear together at the first meeting of the Geographical Society in May.

UNDER Colonel Woodthorpe, the work of surveying our new Burmese territory is proceeding apace. Up to the end of January the out-turn of work amounted to 800 square miles on the $\frac{1}{4}$-inch, and 260 miles on the $\frac{1}{8}$-inch scale.

THE narrative of Baron Nordenskjöld's memorable journey into the interior of Greenland in 1883, is now appearing in instalments in the German journal *Globus*, profusely illustrated.

TWO Expeditions are being sent out by the Russian Geographical Society this year: one, under J. P. Kusnetzow, to investigate the flora of the Northern Urals; and another, under Prince Massalsky, to continue his Transcaucasian researches, which include both botany and ethnography.

VALENCY AND RESIDUAL AFFINITY[1]

II.

METALLIC CONDUCTION.—I do not propose in any way to discuss metallic conduction, but merely to call attention to some of the analogies between it and electrolytic conduction.

It is conceivable, and it would appear probable from the fairly regular manner in which the electrical resistance of most pure metals decreases as the temperature falls, the coefficients of change being practically very nearly the same in all cases, that the increase in resistance as temperature rises is mainly due to the increase in molecular inter-distances. As a rule, resistance increases on the passage of a metal from the solid to the liquid state, but there are noteworthy exceptions from which it would appear probable that even in pure metals conductivity to some extent depends on molecular composition: thus the conductivity of bismuth increases at the moment of fusion from 0·43 to 0·73 of that of mercury at 31°, and that of antimony from 0·59 to 0·84 (L. de la Rive, *Comt. rend.*, 1863, lvii., p. 691); it is well known that bismuth contracts considerably on fusion, and this is probably also the case with antimony. Again, according to Bouty and Cailletet (*ibid.*, 1885, c., p. 1188), the resistance of mercury decreases at the point of solidification in the ratio 4·08 : 1; this is a remarkable increase in conductivity, and it is difficult to believe that it is wholly due to mere contraction of volume.

That the behaviour of alloys is worthy of far more attention than it has hitherto received appears most clearly from the few data at disposal. I would specially call attention to the curve given by Prof. Lodge as representing the specific conductivities of the copper-tin alloys (Phys. Soc. Proc., 1879-80, iii., p. 158). The general resemblance of this curve to that given by F. Kohlrausch for mixtures of sulphuric acid and water appears to me to be in the highest degree suggestive.

Valency—Chemical Change.—Notwithstanding the fierce controversy which has been waged between the advocates of the doctrine of fixed valency, our views on the subject are still in an unfortunate degree unsatisfactory and indefinite. Even those—and they probably form a large majority—who regard valency as a variable, dependent both upon the nature of the associated radicles and the conditions—especially as to temperature—under which these are placed, often hesitate to attribute a valency sufficiently high to account for every case of combination; in fact, both parties agree in distinguishing "atomic" from "molecular" compounds, and differ only as to where the line shall be drawn.

It is difficult to over-estimate the importance of the theory of valency: its application has led to an enormous extension of our knowledge of carbon compounds especially, and it has furnished us with a simple and consistent system of classifying the mighty host of these bodies; but, on the other hand, it may be questioned whether it has not led us away from the search into the nature of chemical change, and even if the introduction of the terms saturated and unsaturated has not had a directly pernicious effect. The almost universal disregard of molecular composition as an important factor in chemical change in the case of solids and liquids, and the popular tendency to overlook the fact that our formulæ of such bodies are purely empirical expressions, has undoubtedly exercised a prejudicial influence.

No known compounds *are saturated*: if any were, such would be incapable, I imagine, of directly taking part in any interaction, and in their case decomposition would necessarily be a precedent change. The paraffins are apparently, of all bodies, the most inert and the most nearly saturated,[1] and next to them comes hydrogen—the unsaturated character of which is displayed in interactions such as occur at atmospheric temperatures between it and platinum and palladium, and when it displaces silver from silver nitrate or certain of the platinum metals from their salts. One of the most striking instances, perhaps, of popular error in this respect is water, which is always regarded as a saturated compound, although its entire behaviour, and especially its physical properties, characterise the molecule H_2O, I think, as that of an eminently unsaturated compound: I fail to see how, otherwise, we are to explain the high surface-tension and high specific heat of liquid water, its high heat of vaporisation, and its imperfectly gaseous behaviour up to temperatures considerably above its boiling-point, let alone its great solvent power and its tendency to form hydrates with a multitude of compounds—*especially oxygenated* compounds, be it added.

The theory was brought most prominently under the notice of chemists by Helmholtz in the last Faraday Lecture, that electricity, like matter, is, as it were, atomic, and that each unit of affinity or valency in our compounds is associated with an equivalent of electricity—positive or negative; that the atoms cling to their electric charges, and that these charges cling to each other. Thus barely stated, this theory does not appear to take into account the fact that the *fundamental* molecules, even of so-called atomic compounds, *are never saturated*, but more or less readily unite with other molecules to form molecular compounds—molecular aggregates; and unless the application of the theory to explain the existence of such compounds can be made clear, chemists must, I think, decline to accept it. The impression which the facts make upon the mind of the chemist certainly is (1) that no two different atoms have equivalent affinities; and (2) that affinity is a variable depending on the nature of the associated elements: but, owing to the recognised complexity of nearly all cases of chemical change, it is difficult to draw any very definite conclusion on this point.

If, however, the nature and properties of so-called molecular compounds generally be considered, and if an attempt be made to form any conception of their constitution, one striking fact is

[1] Revision and extension of a paper by Prof. H. E. Armstrong, F.R.S., communicated to the Royal Society last year. Continued from p. 572.

[1] It is probably more correct to place nitrogen first in the list, as being the most inert substance known.

noticeable, viz. that the *metals* in them apparently retain the properties which they exhibited in the parent atomic compounds. Everyone knows the marked difference in properties of ferrous as contrasted with ferric salts: they differ not only in chemical behaviour, but also in their physical properties, and are readily distinguishable by their colour. The properties of the ferrous molecular compounds, however, are those of the simple ferrous compounds: ferrous potassium chloride, for example, $Fe_2Cl_4 . Cl_2K_2$, is a green salt much like ferrous sulphate. Facts such as these have led me to suggest that in such cases the formation of the molecular compound is due to the attraction of the negative element of the one "atomic" compound by the negative element of the other, the metal having no influence except that the amount of affinity of which the negative element is possessed depends on the nature of the metal with which it is associated. It would in fact appear that hydrogen and the metals generally may be regarded as the analogues of the C_nH_{2n+1} and C_nH_{2n-7} hydrocarbon radicles, and that their compounds with negative elements may be likened to unsaturated hydrocarbons of the form $C_nH_{2n+1} . CH . CH_2$. We know that whenever such a compound enters into combination, the C_nH_{2n+1} radicle takes no part in the change, combination of whatever kind being effected by means of the unsaturated radicle, $CH . CH_2$, with which it is associated. I do not mean to contend that the metals are fully neutralised in their compounds, but merely that as a rule they behave as though they were saturated, just as do the C_nH_{2-7} radicles derived from the benzenes. There can be little doubt that an absolute distinction must be drawn between hydrogen and the metals on the one hand, and the non-metals on the other. Regarding the facts in the light of our knowledge of carbon compounds, it is difficult to resist the conclusion that the differences observed are due to differences in structure of the stuffs of which the elements as we know them are composed, the which differences condition perhaps a different distribution of the electric charge or its equivalent, in the case of each element.

ADDENDUM, *April* 1887.—I will now venture to call attention to the points which after a year's further consideration of the subject appear to me of special importance.

We are as far as we ever were from being able to define a "simple electrolyte" in the chemical sense—that is to say, to define the class or classes of compounds to which simple electrolytes belong. The investigation of the electrical behaviour of *pure* compounds is therefore of the highest importance; it is essential, however, to bear in mind that not only must pure compounds be studied, but scrupulous care must be taken to guard against a possible decomposition of the substance under examination, either by heat alone, or by contact with the electrodes or the containing vessel. I believe that the conclusions which Clark based on his most interesting observations on the electrolysis of mercuric salts are vitiated by some such effect having been overlooked. The experimental difficulties surrounding the problem are therefore very great; and the more hopeful method of attacking it in many cases would appear to be that adopted in Kohlrausch's experiments on the specific resistance of water: in other words, to determine the influence of impurities.

A similar problem relates to the possibility of basing a definition of a non-metal as distinct from a metal on electrical properties. It is well known that no consistent definition can be given, and that we are at present obliged to base our division of the elements into metals and non-metals on general considerations. Now, although metals differ enormously in specific resistance, the metals as a class oppose a comparatively feeble resistance to the passage of electricity, and moreover resistance always increases as the temperature of a metal rises; it is therefore noteworthy that not only is the specific resistance of non-metals, such as carbon, phosphorus, selenium and sulphur, enormously great in comparison with that of metals, but that it diminishes as temperature rises: non-metals therefore behave in this respect as electrolytes, and as no special precautions have hitherto been taken to obtain pure non-metals for the purpose it is well worth while to ascertain if the specific resistance offered by non-metals be not the greater the nearer the approximation to purity.

To determine the valency or atom-fixing power of an element, according to present views, it is necessary to determine the number of atoms which can enter into direct association with an atom of the element considered; and this necessarily involves a discussion of the nature of "atomic" as distinct from "molecular" compounds. The electrical hypothesis that an atom of unit valency carries unit charge, a dyad two such charges, a triad three, involves the more specific determination of the number of charges which are associated with any particular atom; but, again, on this hypothesis we have to determine whether any real distinction can be drawn between atomic and molecular compounds, and whether an atom having, say, unit charge, has the power of combining with more than a single atom. My own view certainly is that atomic and molecular compounds are specifically distinct; and that in the latter the number of atoms associated with what may be regarded as the grouping element or elements in the compound is in excess of the number of unit charges which the particular element or elements of necessity carry. Taking nitrogen as an example, it appears to me that the whole of the evidence to be derived from the study of nitrogen compounds is compatible with the assumption that nitrogen carries at most three charges: that it is a triad, in fact; and I am inclined to regard the ammonium compounds of the type $NH_3 . HX^1$ as molecular compounds in which the residual affinities of N and X^1 serve to unite H_3N with X^1H. The more I study the question the more I incline to the belief that sooner or later we must accept Kekulé's ruling, unfashionable as this has become of late years.

The foregoing may appear to many to be but a restatement of the tenets of the advocates of the doctrine of fixed valency. It appears to me, however, that in the hypothesis of a definite unit charge—in other words, of a definite unit valency—we have a conception which for the first time enables us to frame a consistent doctrine of valency: a given atom may be assumed to carry under all circumstances a certain definite charge, and the problem which the chemist has to determine is, firstly, the number of unit charges associated with any particular atom, and, secondly, the manner in which the charge is, as it were, distributed when the atom is brought into association with other atoms. The following illustration will perhaps serve to make my meaning clear. Let unit charge or unit valency be regarded as a unit "line of affinity" passing through the atom, and let it be supposed that the atom moves upon this line of affinity with a degree of freedom depending on its nature; then it may be supposed that combination between two atoms consists in the overlapping of the lines of affinity. If each atom move out to the end of its line of affinity, no part of the line will overhang; the molecule will consequently be saturated; there will be no residual affinity. On this view the stability of a molecule will depend on the extent to which the lines of affinity of the constituent atoms *overlap*, and its tendency to associate with other molecules will depend on the extent to which the lines of affinity of the constituent atoms *overhang*. For example, it may be supposed that in ordinary chlorine the two atoms of which the molecule consists have moved out near to the end of the lines of affinity, so that there is but little overhang: the molecule is therefore of considerable stability, but forms unstable combinations with other molecules; in iodine, on the other hand, it may be supposed that the atoms are closer together, the lines of affinity overlapping less than those of chlorine; consequently the molecule is less stable than that of chlorine, but may form more stable molecular compounds as the lines of affinity overhang to a greater extent than do those of chlorine. It is possible in this way to understand that an atom which carries but unit charge—a monad, in fact—may enter into association with two distinct atoms. Adhering to the above symbolic language, it may even be suggested that perhaps the difference between a non-metal and a metal may be that the structure of the non-metals is such that they move with difficulty upon their lines of affinity, and probably in a very limited number of directions, and with unequal freedom in different directions; and that the structure of metals is such that they move with comparative freedom upon their lines of affinity, in some cases even with complete freedom, and almost equally so in several directions.

Speculations such as these are of value only if they serve as a guide to further inquiry. I venture to put them forward in the hope of inducing chemists to devote more attention to the study of molecular compounds, for it is in this direction that we are likely to gather most important information as to the valency of elements other than carbon and hydrogen. Of late years such inquiries have been but rarely pursued, and no doubt they are less attractive than those which result in some new synthesis or the determination of the constitution of an organic product; but their future value will be great, and the number of workers is

now so large that our sense of proportion demands that attention should no longer be directed almost exclusively to the study of carbon compounds.

There is one other problem to which I would direct attention —the study of liquid diffusion. No interpretation of the remarkable results obtained by Graham has yet been given, and they appear in many cases to be quite at variance with the results of chemical inquiries. But there is a striking parallelism to be observed between Graham's results and those obtained on determining the electrical conductivity of solutions. Applying the view which I hold regarding the electrolysis of composite electrolytes to liquid diffusion, it appears to me not improbable that diffusion may be to a large extent the outcome not so much of the proper motion of the molecules of the dissolved substance as of a propulsive action exercised by the molecules of the solvent. The molecules in a mass of water we know may be assumed to be moving in every direction, and this being the case they would tend to carry other molecules along with them: the extent to which this action would take place would, however, largely depend on the attraction which exists between the molecules of water and those of the dissolved substance. From this point of view it appears of considerable importance to extend the study of liquid diffusion to dilute solutions. It may be added that this hypothesis would probably account for the behaviour of colloids, as these are known to be chemically neutral substances; in fact, they are compounds almost destitute of residual affinity.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

KING'S COLLEGE, LONDON.—Prof. W. Grylls Adams, F.R.S., will deliver a course of lectures on Electro-Magnetism, Magneto-Electricity, the Testing of Motors and Dynamos, Electric Lighting, and Transmission of Power, during the present Term.

A course of practical work in Electrical Testing and Measurement with especial reference to Electrical Engineering will also be carried on under his direction in the Wheatstone Laboratory.

The lectures will be given once a week—on Mondays, at 2 p.m.,—and the Wheatstone Laboratory is open daily from 1 to 4, except on Saturdays.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, March 31.—"Note on the Development of Voltaic Electricity by Atmospheric Oxidation." By C. R. Alder Wright, D.Sc., F.R.S., Lecturer on Chemistry and Physics, and C. Thompson, F.C.S., Demonstrator of Chemistry, in St. Mary's Hospital Medical School.

Whilst investigating processes for the manufacture of cuprammonium hydroxide (now used commercially on a considerable scale) we noticed that if the air supply be greatly in deficiency relatively to the bulk of the copper, under certain conditions the solution is but little coloured, containing copper dissolved principally as cuprous, and not as cupric, oxide. This might, perhaps, be anticipated *a priori*, inasmuch as it is well known that blue cupric solution in ammonia, when digested with metallic copper in the absence of air, takes up a second equivalent of copper, becoming colourless cuprous solution; but further experiments seem to indicate that the production of cuprous oxide under the oxidising influence of a limited supply of air is the primary action, and not merely a secondary result.

When a sheet of copper is kept out of direct contact with air by being immersed in ammonia solution, oxidation of the metal is gradually effected by virtue of the dissolving of oxygen from the air at the surface of the fluid, and diffusion of the oxygen solution to the vicinity of the copper. This action is an extremely slow one if the copper be covered by some depth of fluid, and if the setting up of convection currents through heating or evaporation be prevented by keeping the vessel perfectly at rest and at an equable temperature, and well closed to prevent escape of ammonia; but if these precautions be neglected it goes on much more rapidly, and the liquid comparatively soon becomes blue; it can, however, be also materially accelerated by arranging horizontally on the surface of the fluid a plate of platinum or other electrically conducting material not chemically acted upon by the fluid, and connecting this by means of a wire, &c., with the copper plate. The upper conductor, or *aëration plate* as it may be conveniently termed, being simultaneously in contact with the atmosphere and fluid, attracts to its surface a film or aura of condensed gases, the oxygen of which becomes gradually transferred to the copper, a voltaic current circulating through the fluid and connecting wire. Cuprous, and not cupric, oxide thus results, dissolved in the ammonia solution in contact with the copper plate, the mechanism of the reaction being conveniently represented by the scheme—

$$\begin{cases} \text{Copper plate} \quad Cu_2 \mid OH_2 \mid OH_2 \mid O \ \text{Aëration plate,} \\ \text{Copper plate} \mid Cu_2O \mid H_2O \mid H_2O \mid \text{Aëration plate,} \end{cases}$$

water being represented as the electrolyte for simplicity's sake. The air film on the aëration plate being constantly renewed by absorption from the atmosphere, the process goes on continuously as long as the two plates are connected together by the wire. This wire may be lengthened at will so as to make the current which passes through it whilst the action goes on relatively stronger or weaker according to the amount of resistance introduced into the circuit; and by including a galvanometer or silver voltameter in the circuit the ordinary phenomena due to the passage of currents are readily recognisable.

The maximum E.M.F. thus capable of development varies considerably with the strength of the ammoniacal solution, being the less the weaker the fluid; addition of common salt or of sal ammoniac to the liquid notably increases the E.M.F. and diminishes the internal resistance of the cell. Spongy platinum in a thin layer as the aëration plate gives higher values than thin platinum foil; the highest numbers thus obtained, using pretty concentrated ammoniacal brine, fell but little short of 0·8 volt; or somewhat less than the E.M.F. corresponding with the heat of formation of cuprous oxide,[1] since, according to Julius Thomsen, $Cu_2, O = 40,810$ = about 0·88 volt.

It is obvious that this copper atmospheric oxidation cell has a close connexion with the "air-battery" described in 1873 by Gladstone and Tribe (Roy. Soc. Proc., vol. xxi. p. 247) in which what is virtually an "aëration plate," consisting of a tray full of crystals of silver is used, opposed to a copper plate immersed in a solution of copper nitrate. Cuprous oxide is formed in both cases, in virtue of the indirect combination brought about between the oxygen of the air and the copper: but there is this great difference between the two (apart from the cuprous oxide being deposited as such in Gladstone and Tribe's arrangement, and being kept in solution in ours), that in the one the cuprous oxide is formed *at the surface of the copper plate* itself, and in the other *at the surface of the aëration plate.* This essential difference is embodied in the above depicted scheme as compared with the following one which represents the action in Gladstone and Tribe's cell:—

$$\begin{cases} \text{Silver} + O \left| \begin{matrix} Cu(NO_3)_2 \\ Cu(NO_3)_2 \end{matrix} \right| \begin{matrix} Cu(NO_3)_2 \\ Cu(NO_3)_2 \end{matrix} \left| \begin{matrix} Cu \\ Cu \end{matrix} \right\} \text{Copper.} \\ \text{Silver} \left| \ O \begin{matrix} Cu \\ Cu \end{matrix} \right| \begin{matrix} (NO_3)_2Cu \\ (NO_3)_2Cu \end{matrix} \left| \begin{matrix} (NO_3)_2Cu \\ (NO_3)_2Cu \end{matrix} \right| \text{Copper.} \end{cases}$$

One result of this difference is that the surface of the aëration plate in the ammonia cell is kept constantly the same, whereas in the nitrate cell it is continually changing its character through deposition of solid cuprous oxide on the silver: in consequence of this deposition, whilst the E.M.F. of the ammonia cell, *cæteris paribus*, is constant, that of the nitrate cell is continually varying. Gladstone and Tribe, moreover, only obtained an E.M.F. of $\frac{8}{83}$ to $\frac{11}{83}$ of a Daniell, or about 0·104 to 0·143 volt, even under the most favourable conditions, viz. when the cell was connected with an electrometer; whilst four or five times this amount is indicated by the cells examined by us.

Following up the ideas suggested by the above observations, we are making a number of experiments with a variety of analogous combinations, in which atmospheric oxidation constitutes the essential chemical action taking place; by varying the nature of the aëration plates, the metals dissolved, and the liquids employed (as also by substituting other gases, *e.g.* chlorine, for air), a large number of combinations are obviously obtainable. Some of those which we have so far examined present points of considerable interest, the oxidising action exerted under favourable conditions being strongly marked: so much so that certain metals, *e.g.* mercury and silver, not ordin-

[1] The actual chemical change going on in the cell is the synthesis of cuproso-ammonium hydroxide, so that the (unknown) heat of solution of cuprous oxide in ammonia should be added to this to obtain the total heat development.

arily prone to atmospheric oxidation, can under suitable conditions be gradually oxidised and dissolved in appropriate liquids, just as the copper is dissolved in the ammonia in the cell above described; these actions, moreover, being accompanied by the development of currents of strength sufficient to cause measurable amounts of electrolytic decomposition outside the cell, *e.g.* in a silver voltameter.

"Action of Caffein and Theine upon Voluntary Muscle." By T. Lauder Brunton, M.D., F.R.S., and J. Theodore Cash, M.D.

Caffein and theine both cause rigor in the voluntary muscles of frogs (*Rana temporaria*). The action is, however, very variable, the rigor being sometimes exceedingly well marked, and at other times not observable. Theine seems to be rather more powerful than caffein, but the quantitative difference between them is slight. There is, however, a marked qualitative difference between them, inasmuch as theine tends to produce rhythmical contractions in the muscle. A variation is observed in the action of the alkaloids on the different muscles of the same frog.

The addition of lactic acid to a solution of theine or caffein causes the rigor to appear sooner, develop more rapidly, and attain a greater maximum, and a somewhat similar effect is produced by calcium chloride. Potash retards and diminishes the action of theine or caffein. One phenomenon which seems deserving of attention is the rhythmic contraction of the muscle produced by theine. This rhythm is so slow that it would escape attention unless a very low rate of speed were used in the recording apparatus; it is sometimes as slow as from three to about one contraction per hour; it may continue for twenty hours. In one instance we observed the remarkable phenomenon to which we have given the name of pseudo-rigor; in this experiment the application of the theine was followed by slight relaxation of the muscle, to this succeeded an equal contraction, and then followed great relaxation below the normal, so great indeed that the negative curve below the abscissa strongly resembled the positive curve of contraction due to rigor in most other experiments.[1]

"Contributions to our Knowledge of the Connexion between Chemical Constitution and Physiological Action. Preliminary Communication on the Action of certain Aromatic Bodies." By T. Lauder Brunton, M.D., F.R.S., and J. Theodore Cash, M.D.

The distinctive action of the lower members of the fatty series is their stimulant and anæsthetic action on the nerve-centres.

The members of the aromatic series also affect the nervous system, but they appear to affect the motor centres more than the sensory, so that instead of producing anæsthesia, like the members of the fatty series, they tend rather to produce tremor, convulsions, and paralysis. Benzene, chlorobenzene, bromobenzene, and iodobenzene are all somewhat similar in their action on frogs; the halogen radicals not modifying the action of the benzene to such an extent as they do in the case of ammonium salts. The voluntary muscles are weakened by them, and there is a slight tendency to paralysis of the motor nerves; but the action is chiefly exerted upon the brain and spinal cord. The brain is first affected, as shown by general lethargy and disinclination to move. Next the cord is affected; motions are imperfectly performed, and there is a tendency to general tremor on movement resembling that observed in disseminated sclerosis; sometimes, however, the tremor is observed independently of movement.

The addition of hydroxyl to the benzene nucleus intensifies the convulsant action, so that oxybenzene (carbolic acid) and dioxybenzene cause convulsions in frogs, and trioxybenzene causes jerkings, though of a slighter character.

Zoological Society, April 5.—Prof. W. H. Flower, F.R.S., President, in the chair.—The Secretary read a report on the additions that had been made to the Society's menagerie during the month of March 1887.—Mr. F. Day exhibited and made remarks on a specimen of a Mediterranean fish (*Scorpæna scrofa*), taken by a trawler off Brixham early in March last, and new to the British fauna.—Mr. J. H. Leech exhibited some specimens of new butterflies from Japan and Corea, and gave a short account of his recent journeys to those countries in quest of Lepidoptera.—The Secretary read a letter addressed to him by the Rev. G. H. R Fisk, of the Cape Colony, respecting the killing and eating, by a shrew, of a young venomous snake (*Sepedon hæmachates*).—Prof. Flower, F.R.S., communicated, on behalf of Messrs. John H. Scott and T. Jeffery Parker, of the University of Otago, N.Z., a paper containing an account of a specimen of a young female *Ziphius*, which was cast ashore alive at Warrington, north of Dunedin, New Zealand, in November 1884.—Mr. Richard S. Wray read a paper on the morphology of the wings of birds, in which a description was given of a typical wing, and the main modifications which are found in other forms of wings were pointed out. One of the principal points adverted to was the absence, in nearly half the class of birds, of the fifth cubital remex, its coverts only being developed. The peculiar structure of the wings in the Ratitæ and the *Sphenisci* was also commented upon.—A communication was read from the Rev. H. S. Gorham, on the classification of the Coleoptera of the division Languriides. The author pointed out the characters which, in his opinion, were available for the systematic arrangement of this family of Coleoptera, and for its division into genera. The subject had hitherto not received the attention it deserved, and several errors had gained currency, owing to the hasty and insufficient way in which the structure of these insects had been analysed. He added an analytical table of about forty genera, many of those proposed being new. Further notice of the American genera would soon appear in Messrs. Godman and Salvin's "Biologia Centrali-Americana."

Mathematical Society, April 7.—Sir J. Cockle, F.R.S., President, in the chair.—The following papers were read, or taken as read:—On the intersections of a circle and a plane curve, by Prof. Genese.—A new theory of harmonic polygons, by the Rev. T. C. Simmons.—On some properties of simplicissima, with especial regard to the related spherical loci, by Mr. W. J. C. Sharp.—On Briot and Bouquet's theory of the differential equation $F\left(u, \frac{du}{dz}\right) = 0$, by Prof. Cayley, F.R.S.—Two points in the plane of a triangle and a cubic through them, by R. Tucker.—A tetrahedral note, by Dr. Wolstenholme.

EDINBURGH

Royal Society, April 4.—Dr. J. Murray, Vice-President, in the chair.—Prof. Tait communicated a note by Prof. Cayley, on a formula for $\Delta^n o^i / n^i$, when n and i are very large numbers.—Mr. R. Kidston read the first part of a paper on the fossil flora of the Radstock series of the Somerset and Bristol coal-fields (Upper Coal-measures).—Dr. Sang read a paper on the achromatism of the four-lens eye-piece, describing a new arrangement of the lenses. He also read a note on an effective arrangement for observing the passage of the sun's image across the wires of a telescope.—Prof. Turner read a communication by Mr. F. E. Beddard, on the structural characteristics of certain new or little-known earthworms. Five new species found in Australia and New Zealand were treated of.—Prof. J. Geikie discussed the geology and petrology of St. Abb's Head.

PARIS

Academy of Sciences, April 12.—M. Janssen, President, in the chair.—On the relations that exist between cyclones and concurrent storms and hurricanes, by M. H. Faye. From an attentive study of the synoptical storm charts of the United States Signal Service, the author is able to confirm the conclusions already drawn by M. Marié-Davy from the meteorological observations made at the Paris Observatory so far back as the year 1864. It is shown (1) that tornadoes, hurricanes, and hailstorms are simply secondary phenomena directly associated with the central cyclonic movement; (2) that in the United States their trajectories have no general relation either to the isobars or to the normal atmospheric currents; (3) that these relatively short trajectories are parallel to the vast cyclonic trajectories at the moment when these local phenomena arise; (4) that they all lie on the right flank of the cyclone itself, which may thus be regarded as a complex meteorological system accompanied on its right side by whole colonies of destructive tornadoes and hurricanes with their attendant waterspouts, hailstorms, and torrential downpours, all moving together across seas and continents. The whole movement is regulated by the simple law of the mechanics of fluids, wihch determines the formation of spirals or vortices in the upper atmospheric regions. The surprising variety of the physical effects produced by the movement is simply due to the descending vortex, which, as in our electric machines, suffices to bring into contact and set in violent motion aërial masses lying far apart, with their consequent differences of temperature, and aqueous particles either frozen or

[1] This phenomenon is difficult to explain, but it suggests the possibility of a transverse as well as a longitudinal contraction in muscular fibre.—March 29, 1887.

in a state of vapour and of positive or negative tension.—On the term "latex" in botany, by M. A. Trécul. In reply to some recent objections made to his comprehensive use of this term, the author here justifies its application both to the contents of the laticiferous vessels and to the product of the secreting ducts. The numerous facts brought together in this communication tend clearly to establish the fundamental resemblance between the physical and physiological properties of the contents of the laticiferous vessels properly so called, and of the secreting tubes, so that these two classes of vessels are properly grouped together under the common designation of vessels of the latex.—On some essays made at sea with Capt. Fleuriais' new collimating gyroscope, by M. de Jonquières. The results are given of the observations made with this instrument by Lieut. Baule, of the steamer *La Gascogne*, during a recent trip from Bordeaux to Brazil. Although this was the first application of the apparatus, the observer was able by its means to record the rolling of the vessel with considerable accuracy.—On earthquakes, by M. Oppermann. The author substantially accepts the general view of seismologists, that these disturbances are mainly due to the pressure exercised on the upper crust by the aqueous vapour formed at great depths below the surface by filtration through fissures or porous rocks.—On the winter egg of Phylloxera, by M. P. de Lafitte. The author replies to some misleading statements recently made by M. Donnadieu, and calculated to affect the issue of the experiments which are now being carried on throughout the wine-growing districts of France.—On a complementary experiment relative to waterspouts, by M. Ch. Weyher. The experiments hitherto described had reference only to the artificial formation of the "*buisson*," that is, of the two inverted cones superimposed at their summits. Here a further process is described, by means of which the author has succeeded in producing the complete waterspout, with its tube of vapour attached on the one hand to the centre of the *buisson* and on the other to the centre of the revolving drum placed 3 metres above the surface of the water. To effect this all that is needed is to project a jet of vapour to the neighbourhood of the axis of the vortex, or, better still, simply to heat the water in the large reservoir sufficiently to cause some vapour to rise.—A study of the alkaline vanadates (continued), by M. A. Ditte. Here are treated the vanadates of soda: VO_5NaO; $2VO_5NaO$; $3VO_5,2NaO$; $3VO_5NaO$; $VO_5,2NaO$; $VO_5,3NaO$; and VO_5NaO.—On the upheaval of the south-west coasts of Finland, by M. Venukoff. The topographic surveys recently carried out in Finland show once more that the shores of the Baltic are continually rising. Since the surveys of 1810–15 several islands have become peninsulas, while many shallows have become islands or beaches. On the south-west coast and in the neighbouring Aland Archipelago many places are pointed out by the inhabitants which a few years ago were under water, but which are now grazing-grounds, market-gardens, or cornfields. The local authorities are now taking steps, by means of which the progress of this geological phenomenon may in future be determined with absolute certainty and accuracy.—The sudden death was announced of M. Thollon in the midst of his labours connected with the construction of a great solar chart, on which the distinction between the telluric and solar rays would have been indicated. M. Thollon's name will always be remembered in connexion with spectroscopic studies, which have been greatly advanced by his improved spectroscope and by the device suggested by him for distinguishing rays of solar origin from those due to the terrestrial atmosphere.

BERLIN

Physical Society, April 1.—Prof. von Helmholtz in the chair.—Dr. Pernet spoke on the comparison of barometers, and drew attention to a number of sources of error which must be avoided when reading off a barometer. The speaker has carried out a series of comparisons with corrected standard barometers, aneroid barometers, and the standard barometers of different stations. He finds that the standard barometers of Berlin and Paris correspond exactly within the limits of errors of observation; aneroids do not yield anything like the same exactness that may be obtained with syphon-barometers.—Dr. Pernet also brought a new form of standard mercurial thermometer before the Society, and explained its construction. It consists essentially of the usual bulb and fine tube, which is widened out above and below into two receptacles each of which is capable of holding a mass of mercury corresponding to a column representing 50°. By means of this arrangement the instrument is easily graduated, and admits of any desired adjustment of the zero and graduation; also by varying the amount of mercury with which it is filled the same exactness in reading which is possible between 0° and 50° can be obtained even up to 200°.—Dr. Kötter spoke on the mean rate of flow of a fluid from a small aperture. This rate, as is well known, depends not only upon pressure, weight, &c., but upon a certain constant which is called the coefficient of efflux, and which has been determined to be 0·62. The speaker gave an account, in their historical order, of a number of researches which have been made with a view to determining this coefficient mathematically, and then proceeded to explain his own methods of calculation, which lead to the value $\frac{\pi}{2+\pi}$ established by Kirchhoff and Rayleigh.—Dr. König exhibited a direct-vision spectroscope constructed by Wernicke, which is contained in a glass tube instead of a wooden one, and thus admits of the internal arrangement of the instrument being seen.

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